LIST OF SIGNIFICANT ISSUES WITH EPA'S REVISED FS SECTIONS 3 AND 4

1 INTRODUCTION

This memorandum contains a list of significant issues with EPA's Portland Harbor Site (Site) Revised FS Section 3 dated July 29, 2015 and Section 4 dated August 18, 2015. This list was prepared in response to a request from EPA for the LWG to present their "significant concerns" with EPA's draft FS within 21 days of receipt of the revised FS Section 4 to "help inform the conceptual remedy."[1]

This document presents detailed descriptions of nineteen (19) significant issues. Table 1 demonstrates how each issue could greatly impact the conceptual plan by cross-referencing each significant issue with a) key FS technical themes; and b) the seven CERCLA criteria associated with the detailed analysis of alternatives:

- Two threshold criteria (protection of human health and the environment, and compliance with ARARs), and
- Five balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost).

As demonstrated on Table 1, each and every one of the 19 issues is significant because of the ripple effect it has on numerous components of the detailed analysis of alternatives, and hence the conceptual plan. The ensuing comments for each significant issue describe in detail the fundamental flaws identified with EPA's approach. Collectively, these flaws result in a biased set of analyses aimed at supporting the false premise that removal and treatment is the presumptive remedy for contaminated sediment.

[1] Email from Lori Cohen dated April 7, 2015, conveying a memorandum from Jim Woolford that presented EPA's process and schedule for developing the draft FS, conceptual plan, and meeting with the National Remedy Review Board (NRRB).

Table 1. Categories of Feasibility Study Significant Issues

		Key FS Technical Themes				CERCLA FS Evaluation Criteria						
No.	**Issue**	**Development of Alternatives**	**Implement -ation**	**Cost**	**Detailed Analysis of Alternatives**	**Protective-ness**	**Compliance w/ ARARs**	**Long-term Effectiveness**	**Reduction of Toxicity - Treatment**	**Short-term Effectiveness**	**Implement -ability**	**Cost**
1	Technology Assignments	X		X		X		X		X	X	X
2	Principal Threat Waste	X		X		X		X	X		X	X
3	Remedial Action Levels	X		X		X		X		X	X	X
4	Inclusion of Riverbanks	X	X	X		X					X	X
5	Construction Durations	X	X	X				X		X	X	X
6	Volumes	X	X	X						X	X	X
7	Lack of Integrated Designs	X	X	X			X				X	X
8	Discussion of MNR	X				X		X		X		
9	Dredge Release Evaluation	X	X	X		X	X			X	X	X
10	Perfunctory Alternative Screening	X		X		X					X	X
11	Sheetpiles and Other BMPs	X	X	X			X			X	X	X
12	CDF Acceptance Criteria		X		X		X	X	X		X	
13	Incomplete Evaluation of Alternatives			X	X	X	X	X		X	X	X
14	Limited Long-term and Short-term Evaluation				X	X	X	X		X		
15	Inappropriate Benthic Risk Analysis	X			X	X		X				
16	Cost Estimates			X	X							X
17	Risk Inconsistency	X			X	X		X		X		
18	Inappropriate RCRA and Other Waste Determination	X	X	X	X	X	X	X	X		X	X
19	Low Level of Clarity and Consistency	X	X	X	X	X	X	X	X	X	X	X

Notes:

ARAR - Applicable or Relevant and Appropriate Requirement

BMP - best management practice

CDF - confined disposal facility

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

FS - Feasibility Study

MNR - monitored natural recovery

RCRA - Resource Conservation and Recovery Act

2 SIGNIFICANT ISSUE COMMENTS

1. **Technology Assignments –** EPA's revised FS uses a prescriptive set of technology evaluation criteria to determine which technologies will be applied to which areas of the Site. Although we understand that technology assignments are necessary for FS-level alternative development, the LWG continues to believe that such a prescriptive approach based on an FS level of detail will not appropriately or accurately predict the most appropriate technology assignments for Remedial Design (RD) (see LWG-written comments and discussions from April to July 2014; e.g., LWG 2014a). The LWG disagrees that the prescriptive approach in FS Section 3 should be used moving forward into the Proposed Plan, Record of Decision (ROD), and RD. The LWG's past and current comments are consistent with remediation guidance (EPA 1988, 2005a) as detailed for specific issues discussed below:

    a. As previously commented (LWG 2014a), the LWG has many technical disagreements about the scores that were applied to the various technologies. The scores favor dredging and fundamentally misrepresent how engineered caps are designed as required by guidance (discussed more in Comment 1g below; Palermo et al. 1998). Thus, the LWG cannot agree that EPA's revised FS scoring approach is objective and "unbiased" as EPA asserted at the July 31, 2015 roll-out meeting.

       EPA also is substantially increasing Portland Harbor remediation costs without demonstrating an improvement in the remedy. The overall problems with EPA's technology assignment approach are best illustrated by comparing the actual sediment remedy constructed at the McCormick and Baxter site to the remedy that would have been selected for this area using EPA's technology assignment process. LWG applied EPA's process as closely as possible following the available information in Section 3, including PTW, ex situ treatment, and disposal steps. We determined that the likely construction costs for EPA's approach as applied to the McCormick and Baxter site would be approximately $370 million (with no net present value calculation and excluding any contingency allowance, operations and maintenance costs, and long-term monitoring costs). (Additional details of this analysis can be supplied.) The actual cost of the cap construction at the McCormick and Baxter site was $12 million (EPA 2005b). The McCormick and Baxter capping remedy has been shown to be highly effective through several years of post-construction monitoring. Capping is likely an equally effective technology over much of the rest of the Portland Harbor Site (outside the navigation channel) consistent with the findings of the 2012 draft FS. Thus, for other areas within Portland Harbor like McCormick and Baxter that have potential groundwater plumes, potential NAPL in sediments, potential PTW (using EPA's definitions), and shoreline sediment contamination, this comparison indicates that EPA is increasing Portland Harbor remediation costs by approximately 30 times with no demonstrated commensurate increase in effectiveness or protectiveness of the remedy.

b. EPA does not consider physical and engineering constraints that may preclude feasible dredging of deep contamination in the scoring of removal as a technology (see Figure 3.3-14b). This results in EPA designating removal for many areas and then having to cap or backfill those same areas anyway because complete removal is infeasible. Although Figure 3.3-36 provides a general depiction of depth of contamination, this information is not evaluated as a feasibility issue in the scoring matrix for dredging or any other technology.

c. EPA's approach does not develop alternatives that compare the effectiveness (or other FS criteria) of one technology to another as applied to the same patch of sediments, as is indicated by FS and sediment remediation guidance. EPA (1988) indicates the FS should "assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations, as appropriate" (p. 4-3). EPA (2005a) indicates, "The project manager should take into account the size, characteristics, and complexity of the site. However, due to the limited number of approaches that may be available for contaminated sediment, generally project managers should evaluate each approach carefully, including the three major approaches (MNR, in-situ capping, and removal through dredging or excavation) at every sediment site at which they might be appropriate" (p. 3-2). The LWG reviewed FS alternatives developed for five other large sediment sites (Duwamish, Fox, Hudson, Lower Passaic Focused FS, and Housatonic Rest of the River), and in every case, those studies included alternatives that compared the application of one technology (e.g., dredging) to another (e.g., capping) as applied to the same areas of sediments. The LWG can provide additional supporting documentation on compliance with guidance and precedents at other sites, if desired. In contrast, EPA has provided very few references to support its conclusions and recommendations. Direct detailed comparisons of one technology to another would also allow the community to provide meaningful comment on the tradeoffs between more aggressive options that might result in shorter restoration timeframes and less aggressive options that might have fewer quality of life impacts.

   Beyond guidance requirements, EPA's approach ignores fundamental facts about dredging versus capping in general. As the RALs decrease, the depth of contamination becomes deeper, the dredge volumes increase, and the potential for dredging impacts on stable slopes and nearby structure stability increases. Also, as RALs decrease, the ability of dredging alone to effectively meet the RALs is decreased. And the potential effectiveness of a post-dredging cap or cover to provide chemical isolation of remaining contamination increases. These general facts support the concept that the technology assignments should change at a given location across a range of potential RALs and alternatives.

d. EPA's scoring matrix approach does not consider the relative scores of the various technologies. For example, if dredging and capping have a difference in total score of one point for a particular area, they are likely to be nearly equal in terms of feasibility in that area (no strong preference for either technology is indicated). Conversely, a score differential of 5 would indicate a markedly different relative feasibility that may truly indicate one of the technologies is better suited than the other one to that particular area. Instead, EPA simply picks the highest score without considering the magnitude of the scores.

e. EPA's text is unclear whether the prescriptive technology assignment approach is intended for FS assumptions only or will be the basis of ROD or RD determinations. EPA indicated at the July 31, 2015 roll-out meeting that EPA intended for the prescriptive approach to be used, perhaps with refinements, in the ROD as well the FS. For the reasons stated above, the LWG disagrees. Instead, the ROD requirements for technology assignments should be based on performance metrics (e.g., the technology must meet water quality ARARs) and allow RD site-specific integrated engineering assessments to meet those performance requirements at any given location. The LWG has prepared alternate technology decision trees that illustrate how such a performance-based ROD approach supported by RD engineering assessments can accomplished. The LWG can provide these alternate decision trees to facilitate discussions of Proposed Plan contents and ROD requirements.

f. Many steps in EPA's technology assignment approach lack critical analysis (see Comment 19 for more details). For example, EPA indicates that, in some cases, a post-dredge sand cover with activated carbon intermixed (a "reactive layer") will be placed in areas designated by EPA as PTW, after these areas have already been dredged to the RAL. EPA assumed that 2.5% of the dredged material concentration would remain in the post-dredge surface for long-term effectiveness evaluations. Using a PCB concentration of 200 µg/kg (EPA's highly toxic PTW threshold for PCBs[2]), the post-dredge surface sediment layer would have 5 µg/kg of PCBs, which is lower than EPA's background-based PCB Preliminary Remediation Goal (PRG). EPA does not explain why surface sediment concentrations below background levels would require activated carbon treatment.

g. The LWG disagrees with many of the specific assumptions used in the technology assignment approach related to cap design. EPA creates an artificial distinction between "engineered caps" (or sometimes just called "caps") and "armored caps," which ignores several of the recommended approaches on cap design in the capping guidance documents (Palermo et. al 1998). This fundamental guidance on cap design is not referenced in Section 3. For example, the capping guidance is clear that caps must be designed to withstand erosional forces present (e.g., river currents, propwash, and wave action), and all cap designs include an armor component as necessary to resist those erosional forces. Similarly, all caps must be designed for stability on any sloping surface present, and several techniques exist to engineer stable

[2] See Comment 2 with regards to LWG's disagreements with EPA's PTW approach.

caps on slopes up to 30 to 40% (LWG 2014b). Thus, EPA's determination that "engineered caps" are less feasible in erosional areas than "armored caps" and that certain caps will be less stable on steeper slopes does not consider all the attributes of a properly designed cap as presented in the guidance.

h. EPA's technology assignment approach uses many technically simplistic assumptions, but it is procedurally difficult to follow. EPA's assignment includes two major process steps, a scoring matrix followed by a set of decision trees, with three large decision trees needed just to explain the second major step. There are numerous inconsistencies between the Section 3 text and the figures and decision trees that attempt to explain the approach. Examples of some of these inconsistencies are provided in Comment 19 below. Thus, it is difficult to determine all the technical issues that may exist with the overall approach.

2. **Principal Threat Waste –** The LWG previously commented (LWG 2014c) that a precise identification and highly quantitative evaluation of PTW at the Site is not necessary or productive for completing the revised FS and is not necessary for EPA's selection of a remedial alternative. Per those past comments, EPA's proposed PTW approach is inconsistent with guidance on PTW (EPA 1991) in several respects. The LWG disagrees with EPA's logic and approach for determining PTW.

   First, EPA uses fish consumption scenarios to determine "direct" cancer risk highly toxic thresholds in excess of 10^{-3}. Before applying such thresholds for PTW identification, the presence of actual risks greater than 10^{-3} needs to be determined. In fact, greater than 10^{-3} risk was not found in the EPA-approved Baseline Human Health Risk Assessment (BHHRA) for dioxin/furan TEQ, total DDx, or BaPEq for any scenario evaluated. Therefore, the definition of highly toxic as described by EPA (1991) is only potentially applicable to total PCBs.

   Second, as described in LWG's past PTW comments (LWG 2014c) greater than 10^{-3} cancer risk was found for PCBs in the BHHRA for three fish consumption scenarios: subsistence (mixed diet, fillet), recreational (mixed diet, fillet), and tribal (whole body and fillet). But EPA guidance (1991) describes PTW materials as a source for "direct exposure." The fish consumption pathways are, by definition, indirect pathways from sediment through fish to people, and these pathways do not represent "direct" exposures from sediment contaminants as described in the guidance. See the LWG's 2014 PTW comments for more details on this issue (LWG 2014c).

   Third, the point-by-point application of EPA's highly toxic thresholds is entirely inconsistent with the spatial and temporal scales associated with this indirect exposure as described in the BHHRA. This includes that people catch fish over multiple areas and fishing events and that the fish range across different areas during those timeframes.

   Fourth, EPA uses inapplicable and inferential evidence to identify potentially highly mobile (i.e., NAPL) material in a manner that is inconsistent with the intent of the PTW guidance. The highly mobile aspect of the PTW definition should be applied for NAPL consistent with situations described in the guidance (EPA 1991), such as "pools of NAPLs submerged beneath ground water or in fractured bedrock, NAPLs floating on ground water" or where physical processes are likely to mobilize "source materials" as defined in the guidance. EPA's identification of any potential NAPL as PTW is inappropriate and inconsistent with the guidance. For example, EPA identifies solid tar materials at Gasco as analogous to highly mobile liquids, which the guidance defines as "liquids and other highly mobile materials (e.g., solvents)." Also, at the Arkema Site, continuous cores have been visually logged and hundreds of samples have been analyzed at the laboratory and, to date, no chlorobenzene NAPL has been found in Arkema sediments. EPA also uses any visual trace observations of NAPL, such as "blebs and globules," to identify highly mobile PTW. This approach is clearly inconsistent with the terms used in the guidance, such as "pools of NAPLs" as quoted above. See LWG 2014c for more description of how EPA's highly mobile PTW approach is inconsistent with the PTW guidance.

Also, EPA's PTW approach is inconsistent with the approach taken at other large river sediment remediation sites, including EPA's recent Region 10 ROD for the Lower Duwamish Waterway, where the maximum sediment PCB concentration was 220 mg/kg. Nonetheless, EPA determined the Duwamish sediments are generally "low-level threat waste" (EPA 2013). In comparison, at Portland Harbor, the maximum PCB concentration is 36 mg/kg, and EPA is identifying concentrations of 0.2 mg/kg as PTW. The LWG's PTW comments (LWG 2014c) review the PTW approach at five other large sediments sites, mostly with much higher contaminant levels than Portland Harbor. All of those sites also do not identify specific PTW areas in the FS process.

Additional specific issues related to the PTW text in Section 3 include:

a. EPA defines areas as PTW without including the reliably contained step of the evaluation described in the NCP and guidance (EPA 1991). Without the reliably contained evaluation included, these areas cannot be appropriately defined as PTW. In other words, only the areas that EPA designates as "not reliably contained PTW" have the potential to actually be defined as PTW. See NCP Preamble, 55 FR 8666 at 8703 (March 8, 1990): "Principal threats are characterized as waste that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure)."

b. EPA's not reliably contained analysis using the so called "super cap" approach is also technically incorrect. EPA uses generalized Site-wide groundwater seepage rates for the super cap analysis rather than more localized estimates available in the RI. Further, groundwater control systems exist at both Gasco and Arkema sites, which EPA states were not considered in the analysis. For example, at the Gasco site, the groundwater source control system has been shown to cause negative seepage (i.e., movement of river water down into the sediment bed) over broad areas of the offshore sediments, but EPA's super cap analysis assumes that positive groundwater seepage out into the river is still occurring. Using appropriate seepage parameters where groundwater source control systems exist would result in no identification of not reliably contained material at the Gasco site. A similar analysis is appropriate for sediments offshore of the Arkema site, which has installed a slurry wall and a groundwater extraction and treatment system designed to prevent migration from the uplands to the river. EPA should consider the specifics of that groundwater control system, as well as other areas with significantly lower than average groundwater gradients (e.g., RM 2-4 East).

c. EPA's PTW approach results in large relatively low concentration areas of the Site being identified as PTW. For example, large PTW areas exist outside much of the SMA footprint of the smaller alternatives (e.g., Alternatives B and C), which is a unique circumstance for a sediment FS as far as we are aware.[3] Further, the concentrations that EPA is proposing as PTW would be considered completely safe under other common remedial and regulatory scenarios. For example, EPA's PTW level for PCBs of 200 µg/kg is below EPA's Regional Screening Levels (RSL) for residential soil, which range from 230 to 3900 µg/kg (per EPA's June 2015 RSL residential soil table carcinogenic risk values for total PCBs). DEQ's risk-based residential soil cleanup standard for PCBs is 200 µg/kg. Although EPA indicates that PTW is only a "preference" for treatment, EPA's decision trees indicate that PTW is almost always subject to treatment including reactive armored caps, reactive residual cover layers after PTW is removed, in situ treatment, or ex situ treatment after removal and before disposal. Regarding ex situ treatment, EPA determines that any PTW that is based on NAPL (including trace observations per above) and PTW related to cPAHs or DDx must be ex situ treated. Essentially, the only situation where removed PTW does not need to be ex situ treated is for high concentration materials above the PCBs and dioxin/furan PTW thresholds. EPA's PTW approach contributes substantial ex situ and in situ treatment components to both removal and in-place technologies for all alternatives both inside and outside of SMAs, as well as extensive sheetpiles (and associated costs) for removal in some areas. For example, Alternative B involves ex situ treatment of 240,840 to 321,120 cubic yards (cy) of sediment, which is about 39% of the total volume removed under this alternative.[4] (Although EPA orally indicated on August 27 that much of this volume is due to RCRA hazardous waste determinations, this is not verifiable based on review of the information contained in EPA's cost appendix. See Comment 18 for more comments on RCRA hazardous waste determinations.) Per above, the PTW guidance does not support the need for treatment for all the materials falling within EPA's wide definition of PTW for this Site.

d. EPA is using extremely low dioxin/furan PRGs for PTW determinations that the LWG has previously commented are technically incorrect and not reflective of actual baseline risks (LWG 2014d, 2015a, 2015b). Also, as noted

[3] Also, this outcome is completely contrary to EPA's recent PTW determinations in the Lower Duwamish ROD as noted above.

[4] EPA's volumetric quantities vary inconsistently between different text and table locations. Consequently, this estimate is based on one set of values provided by EPA.

above for PCBs, EPA's dioxin and furan PTW levels are extremely low as compared to other common regulatory programs. For example, EPA's TCDD PTW level is 10 ng/kg in Table 3.2-1, while EPA's soil remedial goal for residential areas is 50 ng/kg.[5]

e. From a purely engineering perspective, it is not be necessary to conduct ex situ treatment of EPA-identified PTW before disposing of this material in a permitted landfill. The landfill acceptability criteria EPA discusses in Section 3 indicate that most of the PTW (as defined by EPA) would be reliably contained at the landfill without need for prior ex situ treatment (not just PCB and dioxin/furan PTW).

3. **Remedial Action Levels –** The LWG disagrees with EPA's dioxin/furan, TPAH, and DDx RALs for reasons discussed below. Also, the problematic absence of any evaluation of benthic risks as part of alternative development in Section 3 is discussed in Comment 3d.

   a. **Dioxin/Furan RALs –** The LWG does not agree that dioxin/furan RALs are necessary to define SMAs or select an effective remedy for the Site. EPA's Table 3.7-1 shows that the percent reduction in time-zero Surface-area Weighted Average Concentrations (SWACs) calculated by EPA for three dioxin congeners. The TCDD and PeCDD SWAC reductions for Alternative G are in the 60- to 70-percent range, which is a relatively low percent reduction as compared to the other RAL chemicals in the table. In contrast, the SWAC reduction for PeCDF starts at 89 percent for Alternative B and ends at 97 percent for Alternative G, which indicates that the range of RALs provides no meaningful differentiation in SWAC reduction for this congener. EPA has indicated (orally on August 27, 2015) that this is due to the paucity of data on detected dioxin/furan at the Site. However, the low data density and high non-detect frequency for the dioxin/furan dataset should be a reason to reconsider the value of dioxin/furan RALs, rather than a reason to explain the poor performance of such RALs.

   The insignificance of these SWAC reductions is more clearly illustrated by comparing the dioxin/furan SWACs achieved to EPA's own dioxin/furan PRGs by calculation of a SWAC exceedance factor—a factor above the PRG. This can be illustrated by comparing SWAC exceedance factors with and without EPA's proposed dioxin/furan RALs as shown in the tables below. The tables show that a RAL set that includes dioxin/furan RALs does not get the remedy meaningfully closer to acceptable risk levels as represented by EPA's PRGs. Details of this analysis can be provided. (EPA indicated orally on August 27, 2015, that EPA does not evaluate Site-wide SWACs, only SWACs on a rolling river mile basis. This is clearly incorrect given that the evaluation of each

[5] Per EPA's website (http://www.epa.gov/superfund/health/contaminants/dioxin/dioxinsoil.html): "For example, the PRG calculated using the new RfD of 0.7 pg/kg-day (picogram per kilogram-day) and EPA non-adjusted exposure factors would be 50 parts per trillion (ppt) toxicity equivalence (TEQ) for residential soil and 664 ppt TEQ for commercial/industrial soil."

alternative in Section 4 starts with a presentation of Site-wide time-zero SWACs. Also, EPA's own dioxin/furan PRGs are based on the osprey egg endpoint, which is assessed on a Site-wide spatial scale in the BERA. Thus, the Site-wide spatial scale is actually the most relevant scale for an analysis of dioxin/furan RALs.) For example, for PeCDD, Alternative F without dioxin/furan RALs achieves SWACs 310 times greater that EPA's PeCDD PRG, while adding the dioxin/furan RALs achieves SWACs for this same alternative that are still 256 times above the same PRG. (Also, conducting this evaluation on a rolling river mile basis would not change this conclusion. Specific rolling river miles would range much further above the PRG than this Site-wide assessment.) Similarly, the addition of the dioxin/furan RALs only slightly reduces the SWAC exceedance factors for PeCDF and TCDD across all alternatives, and none of the alternatives are estimated to achieve SWACs that are below those PRGs.

SWAC Exceedance Factor above the PRGs – without EPA's Dioxin/Furan RALs

Alternative	PeCDD	PeCDF	TCDD
B	409	2.3	9.4
C	407	2.3	9.4
D	401	2.3	9.3
E	360	1.8	6.7
F	310	1.7	6.0

SWAC Exceedance Factor above the PRGs – with EPA's Dioxin/Furan RALs

Alternative	PeCDD	PeCDF	TCDD
B	354	2.1	6.6
C	341	2.1	6.5
D	314	2.0	6.3
E	293	1.4	5.8
F	256	1.3	5.5

Also, for all of the dioxin/furan RALs EPA uses the exact same RAL numeric value to represent more than one alternative. For example, for TCDD, EPA proposes using the same RAL value of 0.002 µg/kg for Alternatives B, C, and D and the same RAL value of 0.0006 µg/kg for Alternative E, F, and G. This approach substantially constrains the alternatives from providing any meaningful changes in SWAC reduction or the SMA shapes and areas defined. Essentially, EPA is only providing three alternatives with regards to dioxin/furans. This appears to conflict with EPA's approach where the RALs (as opposed to technology assignments discussed in Comment 1) are the only real difference among alternatives. Thus, in the case of dioxin/furans, the alternatives have no variation in technology assignments and very little meaningful variation in term of RALs as well.

b. **TPAH RALs –** Per discussions at the 2014 FS technical meetings, the LWG disagrees that TPAH RALs should be used instead of cPAH RALs (expressed as BaPEq). BaPEq is consistent with the methods and results of the BHHRA, which were assessed in terms of total cancer risk from cPAHs on a BaPEq basis. Following the risk-based approach called for in the guidance,[6] RALs should be consistent with the methods and findings of the BLRAs to ensure that sediment remedies are "risk-based" (i.e., result in effective risk reduction). Further, EPA's latest Section 2 human health PAH PRGs are all expressed as BaPEq. Therefore, use of BaPEq RALs allows for a direct comparison on a consistent basis between the RALs and the PRGs, whereas TPAH RALs do not. Further, the use of BaPEq RALs for human health and Comprehensive Benthic Risk Areas (CBRAs)[7] for ecological risks addresses all of the PAH-related potentially unacceptable risks found in the BLRAs.

   Also, the BaPEq RALs should only be applied to human health exposure areas outside the navigation channel consistent with the risk-based approach called for in the guidance. The cPAH risks related to sediment direct contact and shellfish consumption exposures occur only outside the navigation channel (along the shoreline), and as a result, BaPEq RALs associated with these potential risks should be applied in these areas only. The only remaining human health potential unacceptable risk identified in the BHHRA was for the fish consumption scenario, which was determined using cPAH concentration data in fish tissue. There is no valid relationship between cPAH fish tissue and sediment concentrations at the Site, or any other sediments site, due to the rapid metabolism of PAHs by vertebrate fish (see LWG 2014d, 2015a, 2015b for additional details and references). Carcinogenic PAHs represent less than 1% of the cumulative risks to people eating fish and are, therefore, not a good reason to expand the remedy by hundreds of millions of dollars on the basis of a technically inappropriate PRG, given that there is no reasonable expectation that such an expansion could have any meaningful impact at all on the overall fish consumption risk. Because the BaPEq RALs can only be linked to effective risk reduction along the shoreline (using the BHHRA findings and the resulting appropriate PRGs for sediment direct contact and shellfish consumption), these RALs should only be applied along the shoreline outside of the navigation channel.

[6] EPA guidance (2005a) discusses "Risk Management Principles and Remedial Approaches" and clearly describes that the cleanup should use a "risk-based framework"; "select site-specific, project-specific, and sediment specific risk management approaches that will achieve risk-based goals"; and "ensure that sediment cleanup levels are clearly tied to risk management goals" (p. 1 – 5).

[7] See Comment 15 for more details on the LWG's position regarding benthic risk and EPA's removal of the CBRAs from the revised FS.

c. **DDx RALs –** Although the LWG agrees with the use of DDx RALs as a general concept[8] instead of individual DDD, DDE, and DDT RALs in the 2012 draft FS, the LWG disagrees with the upper end of the RAL curve selected by EPA. There is little differentiation in the areas mapped using EPA's B, C, and D RALs. For example, according to EPA's Table 3.3-4, within the RM 7W area, the acreages defined by EPA's DDx RALs for Alternatives B, C, and D are 10, 12, and 15 acres, respectively. EPA further indicates these RALs achieve Site-wide SWACs of 21, 20, and 19 ppb, respectively. Thus, this range of RALs represents virtually no substantial difference in areas remediated or risk reduction likely achieved. Instead, EPA should use DDx RALs of 8000, 1000, and 500 µg/kg for Alternatives B, C, and D, respectively. This RAL set would provide a wider differentiation between the active remediation acres and resulting SWACs achieved across these three alternatives. In addition, the LWG has the following specific concerns about EPA's DDx RAL analysis:

   i. Table 3.3-4 presents an inappropriate comparison of DDx RALs to a SWAC derived for a localized area of RM 6.6 to 7.8. EPA does not explain the basis for evaluating DDx across this area rather than an area that is consistent with the spatial scale evaluated in the BLRAs most related to appropriately calculated DDx PRGs. As noted above, RALs should be developed consistent with the BLRAs to be consistent with FS guidance.

   ii. The LWG's original position in 2011 was to use DDE RALs as a surrogate for DDD and DDT (and as a result, for total DDx). However, EPA expressed concerns in 2011 and again in 2014 FS technical discussions that the DDE RALs, by themselves, might not sufficiently bound areas of elevated DDD and DDT sediment concentrations. No supporting technical basis was provided by EPA for this concern, and none is provided in Sections 3 and 4. The determination of bounding COCs for RAL development is an evaluation that requires best professional judgment that must be clearly explained. In addition, the 2012 LWG draft FS indicates that potentially unacceptable risks associated with DDx are based only on the most conservative fish consumption pathway and are localized to RM 7, where DDx contributes only 3% of the cumulative potentially unacceptable risks. Given that EPA does not explain the reasons for the conversion from separate RALs to one combined set of DDx RALs, the LWG's proposal above may not fully resolve the LWG's concerns regarding EPA's DDx RAL approach.

d. **Comprehensive Benthic Risk Areas –** EPA makes no mention of the CBRAs in the FS Section 3 text or how those risks are addressed through the proposed RALs and SMAs. See Comments 15 and 17 for more information

[8] However, the LWG does not necessarily agree with how EPA made the conversion from separate RALs to a combined DDx RAL or with the EPA's DDx RAL values as noted further below in this comment.

regarding the LWG's position on benthic risk and need for consistency with the risk assessments.

e. EPA indicates in Section 3 that the RALs were selected using RAL curves and considering the zone of maximum incremental SWAC reduction, the zone of marginal incremental SWAC reduction, the knee of the curve, and spatial distribution of the RAL points on the curve. The LWG generally agrees with these RAL selection criteria, which are similar to those stated in the 2012 draft FS. However, a cursory review of the RAL curves presented indicates a wide difference in the RAL points chosen along these curves across the various chemicals. Considering the EPA stated selection criteria either individually or together, there is no discernable consistency in the RAL points selected on the curve for one chemical to the points on the curve selected for another chemical. Thus, the stated selection criteria do not appear to be followed.

4. **Inclusion of Riverbank Soils in the Sediment Remedy –** EPA's new approach for the riverbanks confounds existing and pending regulatory agreements between DEQ and upland PRPs regarding the evaluation and remediation of riverbanks. For example, the Evraz riverbank is being remediated this summer as a DEQ source control action, and the measure is generally consistent with the EPA revised FS approach. However, the Evraz riverbank is still included in the revised FS. DEQ is indicating at the Gasco and Arkema sites that the riverbanks still need to be included in the ongoing upland FSs, even though this would result in identification of likely different riverbank alternatives and remedies simultaneously under two different regulatory programs. Per past LWG comments on EPA's revised FS Sections 1 and 2 (LWG 2014d, 2015a, 2015b), the riverbank soils should remain part of the upland source control program directed by DEQ. This will allow the performing parties the necessary flexibility to integrate the riverbank and sediment remedies in a site-specific fashion that is not bound by broad FS-level assumptions.

   Further, the source control and remediation of riverbank soils needs to be integrated with any adjacent sediment remedy to be feasible and effective. This integration is typically very complex and needs to consider: the areas and depths of soil and sediment contamination, slope stability, slope layback, interactions with surface water runoff and groundwater discharge, potential interference with shoreline and upland structures, erosion protection, vegetation, habitat considerations, and shoreline regulations. EPA addresses this complexity across miles of Site shoreline with a very simplistic analysis and a few broad assumptions that are not well described. Thus, EPA cannot accomplish in the time available a reasonable integration of the riverbank source controls with the sediment remedy in the revised FS. Any riverbank source control not accomplished under DEQ should be integrated with the sediment remedy at the RD phase.

   Beyond the central issue that riverbanks should not be included in the FS at all, the LWG has the following specific concerns with EPA's FS approach for riverbank soils:

   a. EPA indicates, "Caps will likely need to be placed on much of these banks and volumes are estimated by assuming that all the banks are currently vertical and need to meet a minimum slope of 1.7H:1V." Clearly, most of the riverbanks are not nearly vertical, and some of them may currently have a shallower slope than 1.7H:1V. (The rationale for the very specific 1.7H:1V slope requirement, which equates to a nearly 60% slope is not explained.) Further, Section 3 goes on to present the alternatives with a different requirement: "In this alternative, 9,624 lineal feet of riverbank are assumed to be laid back to a slope of 5H:1V and covered with either an armored cap or an engineered cap using beach mix or vegetation." (The rationale for this slope is also not explained.) Consequently, it is unclear whether EPA is assuming slopes will be regraded to 1.7H:1V or 5H:1V or some combination of the two. If EPA is assuming a nearly 60% slope, the cap, backfill, and beach mix materials described in the Section 3 conceptual riverbank design are unlikely to stay in place without considerable additional engineering including potentially further lay back of that slope. Also, EPA does not describe in figures or text which portions of riverbank are included in each remedial alternative.

b. EPA does not present a schematic design that shows how these slope revisions are assumed to occur or are integrated with the adjacent sediment technologies. This raises many questions about the assumed approach, including integration of the slope (whichever slope is assumed) with the sediment technology assignments, where the slope starts and stops, and assumed elevation mark for distinguishing between sediment and riverbank technologies.

c. EPA has included some new DEQ data on riverbank soils contaminant concentrations in this analysis, but the details of those data additions have not been described by EPA, and no supporting database is available to better understand EPA's contaminant distribution decisions for riverbank soils. The RI and FS databases have very specific and detailed data quality and data usability criteria that take considerable time to address so that a consistent overall database is developed. It is unclear whether EPA considered these EPA-directed and long-established project protocols.

5. **Production Rates and Construction Durations –** EPA assumes aggressively fast production rates and construction durations and simultaneously directs numerous requirements for innovative dredge Best Management Practices (BMPs), precision dredging techniques, use of sheetpile barriers in some areas, a centralized transload and upland ex situ treatment facility (which will act as a process bottleneck), and a centralized upland water treatment system (which will also act as a bottleneck).[9] EPA also assumes that the remediation across the entire Site will be conducted as one overall seamless project from start to finish over periods of up to 18 years. Further, the original July 29 draft Section 3 provided insufficient information to determine the exact production rates assumed. EPA provided some additional text on August 14, 2015, that clarified the assumed production rates, but this text does not try to resolve the mismatch between the aggressive production rates and inherent delays caused by the other

[9] See Comment 5c for more discussion of bottlenecks.

extensive dredge requirements. Regardless, EPA estimates that the construction durations will be less than half the pace assumed for the 2012 draft FS (e.g., the Alternative F duration is 28 years in the draft FS and 12 years in EPA's revised FS Section 3, even though EPA also estimates substantially larger dredge volumes for the revised FS). Guidance is clear that the FS needs to fully evaluate the time and cost implications of any process options intended to reduce construction impacts, particularly those associated with unavoidable dredge releases. EPA (2005a) indicates, "Project managers should be aware that most engineering measures implemented to reduce resuspension also reduce dredging efficiency. Estimates of production rates, cost, and project time frame should take these measures into account."

a. Per past LWG comments (LWG 2014e), the LWG disagrees with many of EPA's production rate assumptions and the applicability of data from other dissimilar sites used to support those production rates. In addition, much of EPA's accelerated schedule seems to be driven by assuming that construction will take place for 24 hours per day, rather than 12 hours per day, which was the 2012 draft FS assumption. EPA notes in Section 3, "The daily and weekly durations of removal operations may be refined if community 'quality of life' concerns (such as night-time noise or light pollution) are identified." If these operations are refined to exclude dredging at night, all of EPA's alternative durations will extend out by approximately a factor of two. In the Lower Duwamish Waterway FS, a combination of 12- and 24-hour days were examined (see details below in Comment 5c). Also, the Duwamish early action projects so far have proceeded mostly on a 12-hour/day work schedule, or if they have included longer durations (e.g., the Boeing project work extended up to 20 hours per day), much of this time is not actually spent actively dredging (see Comment 5c). The Lower Duwamish Waterway appears to have less residential neighborhoods within close distance of the remediation area as compared to Portland Harbor, and yet EPA is assuming that there will be fewer quality of life concerns associated with around the clock dredging in Portland Harbor.

   Also, numerous upland support activities beyond just the dredging and capping itself may have a larger impact on the community, particularly at night. It is noteworthy that EPA's Section 4 cost estimate assumes that trucks will transport materials from the transload facility to off-site landfills. For all the alternatives, this represents a huge increase in the amount of local truck traffic through local neighborhoods, with half of that traffic occurring at night. These disturbances would be in addition to traffic bringing equipment, personnel, and materials to the Site for building and operation of the transload and water treatment facilities. Operation of the transload and water treatment facilities would also involve upland noise and light impacts, which are issues that have previously been a concern in the community (e.g., beeping alert sounds from facility vehicles and facility safety lighting).

b. The 24-hours-a-day/6-days-a-week assumption significantly hampers the contractor's makeup time when weather, equipment downtime, adjustments to

BMPs, or other delays slow planned production rates especially on long projects with limited construction windows. Therefore, EPA's aggressive work schedule assumption does not match how that work will likely proceed.

c. EPA does not discuss or appear to include any time for preparation of dredging areas (e.g., placement and removal of silt curtains, and particularly, sheet pile walls), moving operations from one dredge area to another (e.g., stepping time), and placement of materials (EMNR layers, capping materials, backfill, etc.). The Lower Duwamish FS considered many of these additional factors and used a 60% efficiency rate (i.e., dredging only takes place during 60% of the daily construction period). The Duwamish FS also considered days off for holidays, downtime to accommodate associated construction like piling and dock work, weather and other delay days, and a period at the end of each construction window without dredging activity to allow for time to place capping, backfill, and EMNR materials. EPA's FS text addresses none of these issues.

   In addition, EPA does not clearly address the potential effects of process bottlenecks at transload, ex situ treatment, or water treatment facilities. EPA indicated in supplemental production rate text that bottlenecks can be avoided by building very large facilities. However, the implementability issues created by finding and developing very large shoreline properties for this purpose are not discussed in Section 3. Further, the Section 4 cost estimates do not appear to include any water treatment costs and only some aspects of the costs associated with developing a very large transload facility (i.e., EPA assumed 140-acre facility but did not fully cost it). It is entirely unclear to what extent such a large transload facility can be realistically identified and developed considering the current availability of suitable shoreline properties. Under any scenario, the siting and development of sediment and water staging, handling, treatment, and transloading facilities could easily be a multi-year process, which does not appear to be accounted for in EPA's duration estimates.

6. **Volumes –** EPA uses a very simplistic approach to estimating dredge volumes, which has a large potential to substantially underestimate the dredge volumes eventually determined in RD. It is possible that this one issue, by itself, would lead to cost estimates outside the guidance prescribed +50 to -30% range (EPA 2000). However, when added to other issues of inconsistencies and errors noted in Section 3 (see Comment 19 below), EPA's simplistic volume estimating approach could substantially contribute to development of costs well outside this prescribed range. EPA indicates that it used maps contoured using core data, and assigned the depth to the applicable RAL for each 10-foot by 10-foot grid cell on the map. EPA then assumes that each grid cell is removed to this depth in a cookie-cutter fashion with a 1-foot overdredge allowance. EPA calls this the "neat" volume. Unlike the 2012 draft FS, EPA did not determine FS-level dredge prisms. These prisms typically incorporate stable slope assumptions, offsets from structures,

integration with adjacent technologies, and a residual "cleanup" pass depth.[10] EPA's volumes also do not consider engineering factors addressing the uncertainty in FS-level volume estimates as compared to design-level estimates (e.g., allowance for new inventory discovered during design sampling, design-level prisms, and transition slopes from deep to shallow dredge cuts). EPA instead uses general factors of 1.5 and 2 times their calculated neat volume to address all these issues. The result is a very approximate volume estimate and likely a substantial underestimate of future design volumes.

7. **Lack of Integrated Designs –** As described for the technology assignments Comment 1 above, EPA uses a series of broad assumptions or rules to assign the base technologies (i.e., dredging, capping, enhanced monitored natural recovery [EMNR]). EPA also adds numerous process option rules to many of the base technologies that are described by EPA in various subsections to address a variety of other issues not directly related to sediment remediation (e.g., habitat mitigation, flooding concerns, and concerns about the creation of "new land"). In contrast, the 2012 draft FS addressed each issue separately to determine the potential overall effect on remedy costs, without defining specific assumptions on how those issues would be integrated into the overall design. For example, the 2012 draft FS calculates overall habitat mitigation credits and debits for each alternative and assigns overall costs that will compensate for any net debits for each alternative based on data from past habitat mitigation projects. This approach avoids assuming that the mitigation must be constructed and integrated into the remedial design in a specific prescribed way as EPA does in the revised FS. In Section 3, EPA presents broad rules that include:

    - Avoiding "creating new land" in shallow water areas by pre-dredging prior to any cap placement
    - Addressing "habitat mitigation" by filling dredge prisms to pre-existing elevations, laying back riverbank slopes to 5H:1V, and using "beach mix covers" at the surface of some dredge backfills and caps
    - Addressing "flood issues" by pre-dredging cap areas to create a localized balance of fill and cut
    - Addressing dredge residuals (e.g., post-dredge covers)

    The LWG previously commented (LWG 2014f) that the EPA additional rules:

    - Will not accurately reflect future decisions made in RD and that these topics should be determined in design on a site-specific basis
    - Are not able to provide an FS-level integration of alternative features that consistently addresses habitat mitigation, water surface area loss, navigation needs, flood concerns, and dredge residuals control simultaneously
    - Do not account for an allowance for potential future maintenance dredging, potential future deepening, allowable overdredge, and operational buffers such

[10] Although EPA mentions elsewhere that one residual cleanup pass is assumed for dredging operations in general, this is not mentioned in the paragraph describing the volume calculations.

that any caps or covers placed in navigational areas would not be subsequently impacted by navigation or removed by future maintenance dredging.

In fact, some of the rules presented by EPA actually exacerbate one issue while attempting to address another. For example, EPA's rule to fill dredge prisms in an attempt to simply address mitigation issues exacerbates flooding issues by reducing the river hydraulic cross section that would be created by dredging in the first place. Instead EPA should be evaluating the alternatives comprehensively for their potential impact on flood rise using appropriate flood models, such as the HEC-RAS model that EPA required the LWG use and present in the 2012 draft FS. This information should then be used to determine whether any additional flood mitigation costs should generally be added to the alternatives. The EPA-required 2012 draft FS flood modeling found that none of the draft FS alternatives (even those containing substantial capping and CDF facilities) caused substantial rises in flood elevations. Additional examples of the contradictory nature of some of EPA's preliminary rules are provided in past LWG comments (LWG 2014f).

Beyond the LWG's past comments, the EPA Section 3 process option rules create some new LWG concerns including the following:

a. Dredging and then capping back in shallow areas will often reveal higher concentrations of subsurface contaminants, which are then capped. This potentially creates a need for a more robust cap as compared to simply capping lower concentration surface contamination in the first place. Whether dredging and capping back can cost effectively be used to balance flood or creation of "new land" concerns, as compared to designing an overall remedy that balances cut and fill elsewhere, is more easily and cost-effectively addressed in RD.

b. EPA often places backfill, sand, beach mix, and activated carbon in various navigational, intermediate, and shallow sediment areas. EPA pays close attention to erosion concerns for caps in the technology assignment scoring matrix, particularly in shallow areas subject to wave action, but these additional process options are assumed with no apparent consideration of the potential for these materials to stay in place. Placing 6 inches of sand cover after dredging is a standard practice, which accounts for some portion of the material being redistributed across or outside the dredge area. However, EPA appears to make similar assumptions about in situ treatment layers and post-dredge covers incorporating activated carbon. These are considerably more expensive to place and then provide no benefit if subsequently lost through erosion. This is another aspect of how EPA's technology assignments do not accurately predict determinations that will be made in RD using appropriate engineering assessments.

c. It is unclear how the mitigation costs developed in the mitigation appendix (Appendix J) are consistent with the mitigation process option rules that EPA added to the technology assignments (e.g., backfill and beach mix additions). That appendix describes a simplistic approach that assumes that each acre impacted by an alternative provides full habitat function and that the function is completely lost due to the dredging or capping activity. Thus, the presumed habitat benefits associated with some of these process option rules are completely unaccounted for in EPA's mitigation cost analysis. EPA is adding costly options to the alternatives to improve habitat and then simultaneously assuming the addition of those options has no benefit in reducing habitat mitigation costs. This calls into question how these habitat-based process option rules provide any benefit to the revised FS or improve the habitat features of the alternatives developed. Comment 16d discusses the mitigation costing issues in more detail.

8. **Discussion and Analysis of Monitored Natural Recovery Is Biased –** The MNR evaluation includes text scattered across Sections 3 and 4. The overall MNR evaluation presented across these two sections is very limited and technically inappropriate in many respects. Overall, EPA suggests that MNR is potentially appropriate for the Site with many caveats and doubts expressed in that assessment. In actual fact, the case for MNR at the Site is strong given that there are multiple lines of evidence supporting the ongoing occurrence of MNR well in excess of the lines of evidence presented by EPA. The simplistic MNR analysis in Sections 3 and 4, appears to cast doubt on the validity of MNR as a potentially feasible process for the Site, which is a misleading representation of the data.

   In Section 3, EPA presents a very simplistic MNR analysis, which generally assumes that MNR will take place outside any active remediation areas based on: 1) surface to subsurface sediment concentration ratios; and 2) a simple deposition rate calculation using two of the time series bathymetry datasets. In Section 4, EPA slightly expands upon the evaluation of MNR, including a different analysis of the time series bathymetry, a brief discussion of maintenance dredging history as an indication of deposition, and a perfunctory discussion of the 2012 smallmouth fish tissue PCB data. Generally, it is unclear why there are two separate and somewhat conflicting MNR evaluations spread across these two sections, particularly given that neither section references the other.

   EPA's analysis does not include the full lines of evidence strongly supporting the presence of ongoing natural recovery at the Site. The LWG has provided this information in past submittals to EPA including the 2012 draft FS, a detailed presentation of smallmouth bass fish tissue concentrations (Anchor QEA 2013), and estimated equilibrium levels for the Site (LWG 2014d, 2014g). In summary, the lines of evidence for ongoing natural recovery at the Site are:

   - Sources are being progressively controlled. DEQ's latest source control report (DEQ 2014) indicates DEQ has completed source control evaluations and implemented (or will implement) controls on one or more potential pathways at approximately 119 of 168 sites examined in detail to date.
   - The aggregate information from five multi-beam surveys indicates widespread deposition of sediments across many areas of the Site. Although EPA emphasizes the uncertainties of the data, for reasons detailed below, the LWG disagrees these data present substantial uncertainties about deposition.

- Sediment trap and suspended sediment data clearly show that incoming settling sediment has substantially lower contaminant concentrations than most of the Site bedded sediment, which will drive bedded sediment concentrations lower over time.
- Radio-isotope coring data, although limited, indicates deposition rates consistent with other measures such as the bathymetry time series.
- Site surface sediment grain sizes are fine-grained across the majority of the Site, strongly indicating a long term depositional environment exists in these areas.
- Surface to subsurface sediment concentration ratios in most areas of the Site indicate newer surface strata contain lower concentrations than older subsurface strata, which illustrates that surface sediment concentrations are decreasing over time.
- Surface sediment concentrations measured over time (i.e., time series) indicate surface sediments have decreasing contaminant concentrations. The 2012 draft FS data are somewhat limited, but new PCB data collected in 2014 by other parties may provide additional useful information for this line of evidence.
- Smallmouth bass PCB tissue measurements made in 2002, 2007, and 2012 indicate statistically significant declines in tissue concentrations across almost all areas of the Site (Anchor QEA 2013). Differences in sampling and compositing schemes across the years can be controlled to determine statistically valid results.
- Comparisons of sediment profile images collected in 2001 (by the LWG) and 2013 (by other parties) indicate that much of the Site now has well established Stage 3 benthic communities indicative of stable and recovering substrates.
- Simple modeling (such as EPA's SEDCAM modeling, which was not provided in Section 3 or 4) and complex modeling (such as the 2012 draft FS QEA FATE model and coupled dynamic Food Web Model) all generally indicate recovery of surface sediments over a reasonable timeframe toward a relatively consistent range of potential equilibrium levels.

Specific issues relevant to the EPA Section 3 and 4 MNR evaluations include:

a. In Section 3, EPA's MNR text starts by discussing that MNR is not usually selected as a "stand-alone" technology per guidance. Although this is consistent with guidance, neither the LWG nor EPA proposes to use MNR as a stand-alone remedy. The Section 3 text then goes on to list a series of cautions and conditions about MNR in bullet points, apparently intended to support the opening contention that MNR is not a good stand-alone remedy. Further, some of the conditions noted in the bullet points as conducive to natural recovery are actually present or strongly indicated in Portland Harbor. Therefore, the purpose of this discussion in light of EPA's selection of MNR as a component of all alternatives is unclear and should not be relied upon to undermine the substantial evidence supporting MNR as a major component of the overall remedy.

b. EPA's Section 3 discussion of surface to subsurface sediment chemical concentration ratios within the Site is misleading. For example, EPA uses a surface to subsurface ratio of 0.5 (which is more conservative) to indicate likely MNR, whereas the 2012 draft FS uses a ratio of 0.67. EPA does not discuss the rationale for the selection of this more conservative ratio, or why it leads to any more valid conclusions about natural recovery at the Site.

c. EPA's Section 3 discussion of deposition rates within the Site is misleading. EPA appears to have ignored the LWG's comments in October 2014 where the LWG described differences in the definition of areas that are "reliably depositional." EPA continues to use the "typical bathymetric survey measurement error" of 6 inches or 15 cm (which equates to 2.5 cm per year (cm/yr) over the period of 2002 to 2009) to define areas that are reliably depositional. Measurement error in a bathymetric survey is a random error (i.e., there is no bias) with an average value of 0 cm for many measurements. These data are normally distributed, so that a 15-cm measurement error is a very rare occurrence (e.g., at the 3-sigma level, which has a probability of occurrence of less than 1% for a single measurement). Thus, EPA's use of a +15-cm measurement error at a single location (10-foot grid) to specify the 2.5 cm/yr deposition threshold is extremely conservative. Further, evaluating and interpreting bed elevation changes on a 10-foot grid is not appropriate due to inherent measurement uncertainty at this small spatial scale. Averaging bathymetry data over larger spatial scales provides a more reliable method for analyzing bed elevation changes because the effects of measurement error on the results decrease as the spatial scale increases. This approach was used by LWG in the 2012 draft FS to analyze bed elevation changes over a wide range of spatial scales in the Lower Willamette River.

   The uncertainty in EPA's analysis results can be significantly reduced simply by averaging the bathymetry data over slightly larger spatial scales. For example:

   i. Using a 20-foot grid (i.e., averaging of four data points from the 10-foot grid) would reduce the measurement uncertainty by a factor of 2 (i.e., +7.5 cm), which would reduce the deposition threshold to 1.25 cm/yr.

   ii. Using a 30-foot grid (i.e., averaging of nine data points from the 10-foot grid) would reduce the measurement uncertainty by approximately a factor of 3 (i.e., +5 cm), which would reduce the deposition threshold to about 1 cm/yr.

   Thus, using the data over appropriate spatial scales, it can be reliably determined that areas experiencing more than 7.5 cm of deposition over the 6-year period between 2003 and 2009 are depositional (equating to 1.25 cm/yr). This difference between EPA and LWG's approach results in a large change in the amount of Site area characterized as reliably depositional (the LWG method results in 63%; the EPA method results in 47%).

d. In Section 4, EPA uses a different approach that biases results when evaluating temporal changes in bathymetry data between 2002 and 2009 and is inconsistent with recent Sediment Erosion and Deposition Assessment (SEDA) guidance (Hayter et al. 2014). EPA concluded that “many areas of the site are in dynamic equilibrium” and “for many areas of the site, the determination of deposition, and the assertion that burial is a viable long-term recovery mechanism, is highly dependent on which survey pair is selected.” Generally, temporal changes in the Lower Willamette River (LWR) bathymetry (and similar river systems) are dynamic, with alternating periods of gross deposition and erosion occurring in localized areas. The bathymetry data clearly show that net deposition occurs over large portions of the LWR during the overall multi-year period (e.g., 2002 to 2009) examined as discussed in Comment 8c above. The net deposition process during a multi-year period does not typically correspond to steady continuous deposition; net deposition is due to a cumulative increase in bed elevation that results from alternating periods of deposition and erosion, with gross deposition being greater than gross erosion over a long period. This is not a surprising or unusual finding for this or similar river systems. Consequently, EPA’s emphasis on comparisons between various individual pairs of bathymetry surveys ignores the overall trends represented by the bathymetry series as a whole. The FS is also misleading regarding the uncertainty of this information, given these dynamic sedimentation processes are routinely evaluated at sediment remediation sites using time series bathymetry data. Such routine methods are used in the 2012 draft FS and are consistent with the most recent guidance (Hayter et al. 2014). EPA does not reference this guidance in the Section 3 or 4 bathymetry discussions.

e. In Section 4, EPA devotes one paragraph to a discussion of the 2012 smallmouth bass tissue PCB data. EPA indicates that an “exact comparison” between 2002, 2007, and 2012 smallmouth bass tissue data is not possible because the “sampling and compositing schemes vary between years.” The LWG provided a detailed presentation to EPA in March of 2013 comparing the tissue data across these years, including several types of statistical tests and other trend comparisons (Anchor QEA 2013). That LWG presentation showed that, in many respects, the differences in sampling and compositing across sample years can be controlled to obtain statistically meaningful information regarding clear declines in fish tissue PCB concentrations. EPA included in Section 4 the single most simplistic graph from the start of the LWG’s presentation, which was intended to merely summarize the data that are available, not demonstrate observed declines. EPA concludes from this one misused graph that the data are only “suggestive of declines.” The text ignores all of the other detailed information and graphs available that more clearly show the tissue PCB declines, and EPA ignores all of the statistical analysis provided by the LWG. Consequently, EPA substantially understates the role of these data as a strong line of evidence for the effectiveness of MNR at the Site.

9. **Dredge Releases Only Qualitatively Evaluated –** EPA discusses dredge release issues in several paragraphs in Section 3 and evaluates them qualitatively in the Section 4, but neither Sections 3 nor 4 contain any quantitative assessment of potential dredge releases associated with the alternatives. Dredging releases are a well-recognized issue related to the short-term effectiveness of sediment removal that increases both human health and ecological risks. It is one of the main contributors to construction phase environmental impacts, particularly for alternatives that involve substantial dredging, such as those proposed by EPA. Per guidance (EPA 2005a), a comprehensive and quantitative evaluation of those impacts is required:

   - "Generally, the project manager should assess all causes of resuspension and realistically predict likely contaminant releases during a dredging operation."
   - "To the extent possible, the project manager should estimate total dredging losses on a site-specific basis and consider them in the comparison of alternatives during the feasibility study."
   - "Dredging residuals have been underestimated at some sites, even when obvious complicating factors are not present."
   - "Project managers should be aware that most engineering measures implemented to reduce resuspension also reduce dredging efficiency. Estimates of production rates, cost, and project time frame should take these measures into account."
   - "The strategy for the project manager should be to minimize the resuspension levels generated by any specific dredge type, while also ensuring that the project can be implemented in a reasonable time frame."

   The LWG disagrees with several aspects of EPA's limited analysis of dredge releases.

      a. EPA uses limited qualitative evaluations of the range of release rates that can be expected for typical environmental dredging projects and the role of post-residual covers in reducing release rates. In a memorandum provided in 2013 (which are not cited in the revised FS) EPA relies on two recent projects (Lower Duwamish Boeing Plant 2 Early Action Area dredging and the Hudson River Phase 2 dredging) to support the contention that 1 percent overall releases are likely across Portland Harbor. The 1 percent release rate for the Boeing project is not supportable from the actual project data. EPA ignores the six case studies presented in Table 6.2-12 of the 2012 draft FS constructed from 2004 to 2009, all of which are based on detailed site specific data collection as summarized in the table. Thus, EPA is establishing a 1-percent release rate based on one project (Hudson River Phase 2) that appears to be one of the lowest release rates documented to date. Further, EPA is applying this optimistic release rate from a site that is entirely different both chemically and physically from the Portland Harbor Site, which includes 10 river miles of highly varying physical and chemical conditions. The 2012 draft FS provides summaries of six case studies from within the last 10 years with observed average total release rates in the 3% range, and the LWG still believes this is a more realistic assumption for the revised FS. More details supporting the LWG's disagreements on this subject can be provided.

b. EPA describes on page 3-19 relatively detailed requirements for determining dredge completion and post-dredge sampling of the residuals, which in this particular case appears far too detailed for an FS-level discussion and does not appear to help determine the characteristics of the alternatives presented in Section 3. As described under Comment 1, EPA should leave such specific determinations to a performance-based ROD approach supported by a site-specific engineering assessment in RD.

10. **Perfunctory Alternative Screening –** EPA devotes one page of qualitative text to the alternative screening process. Effectiveness, implementability, and cost of Alternatives B through G are briefly discussed. This analysis is insufficient to screen and identify the alternatives that should receive detailed evaluation in Section 4.

    a. For effectiveness, EPA estimates the time-zero SWACs for each alternative immediately after construction by assuming all actively remediated areas achieve a post-construction concentration of zero. However, EPA does not consider whether these SWACs represent a meaningful reduction in sediment relative to unacceptable risk levels or background or equilibrium conditions. Although a full residual risk assessment is not necessary at a screening level, some comparison to risk levels such as appropriately calculated PRGs would provide for a more reliable screening of the alternatives. Further, EPA does not discuss the fact that SWACs immediately after construction are not a good measure of the long-term outcomes for the alternatives or the qualitative similarities and differences in the expected or estimated long-term outcomes of the alternatives (see Comment 14 for more details). EPA further implies that alternatives that rely more on MNR are potentially less effective, although the guidance (EPA 2005a) is clear that there is no presumptive preference for one type of remedial technology or another; rather, the goal is risk reduction.

    b. For implementability, EPA discusses in one sentence that more construction is involved as the alternatives progress from B to G. There is not any actual discussion of the implementability issues involved with any of the alternatives. Using Alternative G as an example, EPA does not discuss the obvious implementability issues associated with such large sediment remediation projects including:

        i. Precision dredging involving 6 to 9 million cy of sediment over 18 years[11] with multiple water quality BMPs and requirements

        ii. Construction on a continuous 24-hours-a-day/6-days-a-week schedule for the entire multi-year project with no allowable time for related construction operations (e.g., the efficiency rate discussed above)

        iii. Import of 2.3 million cy capping and cover material[12]

[11] This is EPA's estimate. Based on the discussion in the durations issue above, we would approximately estimate the time to complete Alternative G at more like 36 years (approximately twice as long as EPA's estimate).

iv. Installation and removal of large areas of sheetpile or coffer dams partially obstructing the navigation channel[13]

v. Ex situ treatment of a significant percentage of the dredged material using thermal desorption, which has never been applied to a sediments project of this size

vi. Institution of permanent regulated navigation areas for 236 acres of caps (11% of the Site)

vii. Building a water treatment plant that will operate for nearly the entire construction period

viii. Finding a 140-acre shoreline property nearby and developing it into a large transload facility

Further, there are significant equipment and contracting issues associated with executing multi-year projects where tens of millions of dollars of equipment need to be mobilized to the Site. Also, this equipment will need to stand idle (or perhaps in a few instances be moved temporarily to coincidentally available nearby construction efforts) for two thirds of each year while the construction window is closed.

c. No cost estimates are presented in Section 3. Costs are typically part of the alternative development process and are one of the characteristics that help describe and compare the alternatives for screening purposes. EPA mentions that costs are expected to increase as the alternative size increases, but this gives no sense of the relative magnitude of the costs across the alternatives (i.e., based on the discussion, it is unclear whether Alternative G is twice as expensive as Alternative B or ten times as expensive).

d. The only alternative screened out in EPA's qualitative screening discussion is Alternative C. EPA's rationale is that between Alternatives B and C there is a small incremental increase in quantities of dredge and borrow materials and a small incremental decrease in the time-zero SWACs estimated for immediately after construction. This logic is unclear. A better common sense measure of effectiveness for unit effort would be to examine alternatives that involve a large incremental increase in active remediation acres while obtaining a small decrease in the SWACs achieved. The table below uses such an approach and compares the incremental change in active remediation

[12] This may not include dredge prism backfill material volumes due to the lack of detail in EPA's estimates.

[13] EPA indicates that sheetpile walls will be constructed in two select areas regardless of water depth, which would result in sheetpiles at least partially inside the navigation channel. But EPA provided no schematic to determine the proposed sheetpile locations. Also, cofferdams or king piles would likely need to be used in water depths in excess of 40 feet, or perhaps even less.

acres and the additional PCB SWAC reduction achieved by moving to each successively larger alternative. This is summarized in the last column as number of active remediation acres required to achieve each percent of SWAC reduction. For example, for Alternative C, an additional 5 acres must be remediated to obtain a 1 percent change in the SWAC. Conversely, for Alternative G an additional 40 acres of active remediation is needed to achieve a 1 percent SWAC reduction. By this more straight-forward measure, Alternative C represents a very effective incremental decrease in time-zero SWACs. As a result, EPA should screen out Alternative G (and possibly Alternative F) and retain Alternative C.

Alternative	PCB SWAC Percent Decrease between Alternatives	Alternative Active Remediation Acreage	Added Acres between Alternatives	Number of Acres Added for Each Percent of SWAC Reduction
B	58	212	212	4
C	4	233	21	5
D	7	286	53	8
E	10	362	76	8
F	12	588	226	19
G	7	868	280	40

11. **Use of Sheetpiles and Other BMPs –** EPA's approach for the assumed construction and use of sheetpile barrier walls as dredge water quality control measures is not explained in EPA's text or appendices. The 2012 draft FS presents considerable information and case studies supporting the contention that sheetpile walls are generally not a cost-effective means of minimizing dredge releases (i.e., they are both expensive and are not water-tight barriers that eliminate dredge releases as is often assumed). Also, the relative cost benefit of using sheetpiles is not discussed or evaluated. The following minimum description of the sheetpile approach would be needed in order to understand the feasibility and costs of this requirement:

    - An approximate schematic showing the area enclosed and the assumed height of the sheetpiles. This would also show whether and to what extent EPA is proposing partial obstruction of the navigation channel with deep water sheetpiling.
    - A description of the type of sheetpiling proposed, particularly given that unsupported sheetpiles will not be constructible in water in excess of 40 feet deep (perhaps shallower). This will require king piles or coffer dams, which are more expensive to obtain, install, and remove.
    - EPA indicates that NAPL areas would be enclosed by sheetpile, but given that some NAPL areas may be capped (if we understand EPA's technology assignment approach correctly), it is unclear which areas would be enclosed and which would not.

- At least some analysis of the incremental benefits that could be expected (if any) relative to the cost of adding sheet pile walls to certain dredging locations.

In addition, the sheetpiling costs used in the cost appendix underestimate the costs of cofferdams, which would appear necessary in some of the water depths and bedded sediment conditions identified by EPA. The revised FS contains no provisions for the extensive bracing/anchoring that would be required to address hydraulic forces and/or restricted embedment depths where bedrock is present.

Similar to the technology assignment (Comment 1) and integrated design (Comment 7) issues, general rules and assumptions for sheet piles, coffer dams, and other water quality BMPs (such as silt curtains) should only be used to support FS-level evaluations. Such FS-level assumptions should not be used as requirements for eventual construction BMPs that are best determined through detailed evaluations that will be necessary during remedial design. Design level water quality BMPs should be determined using a performance-based requirements in the ROD and using engineering assessments in RD (i.e., the performance goal should be to meet the water quality standards consistent with the substantive requirements of water quality ARARs).

12. **CDF Acceptance Criteria and Related Issues –** EPA has changed some of the CDF acceptance criteria and performance standards (Table 3.3-8) since the T4 CDF 60% design, even though EPA references that design as the source of the criteria and standards. The LWG disagrees with many of these changes, particularly because no rationale is provided for why the changes make the remedy more protective or effective. Although every instance of potential LWG disagreements with EPA's new CDF text is not noted here, the LWG disagrees with the following major EPA changes:

    a. EPA indicates that "Sediments that would designate as RCRA or State hazardous waste, whether listed waste or characteristic waste are not eligible for placement in the CDF." However, the T4 CDF 60% design criterion includes the words "without adequate treatment." This is an important distinction that may allow a considerable volume of treated materials to be placed in the CDF. Similarly, EPA unacceptably excludes the "without adequate treatment" clause in the "No Free Oil" criterion.

    b. EPA adds a new criterion regarding the "Waste or Contaminated Media Warranting Additional Management," which EPA defines elsewhere in Section 3 as manufactured gas plant (MGP) related materials that fail the TCLP test for one or more chemicals. As noted above, material that is treated to pass the TCLP test should be acceptable for placement in the CDF to be consistent with the T4 CDF 60% design criteria.

    c. EPA added the words "NAPL" to the "no free oil" criteria from the T4 60% design. As noted above, elsewhere in Section 3, EPA defines NAPL as any instance of oil (e.g., blebs and globules) and including instances of solid tar found at Gasco. Consequently, EPA has revised the T4 CDF 60% design "no free oil" criterion to now exclude a much broader range of contaminated sediments than was originally intended for the T4 CDF design. EPA provides no rationale for why these additional materials could not be effectively disposed of in a CDF.

d. Table 3.3-8 contains text that "alternative standards may be developed during remedial design." This new language causes a great deal of uncertainty regarding potential construction of a CDF moving forward into design. It is unclear why EPA is no longer willing to support the T4 CDF performance standards that were defined through extensive deliberations on that project.

e. Figure 3.3-40 indicates that PTW that is not reliably contained must be disposed of at an upland landfill. The figure also indicates that reliably containable PTW[14] must be treated before placement in a CDF. Thus, EPA appears to use the PTW designation, which guidance intends solely to assist in a "preference for treatment" assessment, to determine whether material can be effectively contained in a CDF. It is inappropriate for EPA to use information related to in situ toxicity of the sediments and/or an in situ model (i.e., EPA's "super cap" modeling, which assumes in situ contaminated sediment conditions and groundwater movement) to determine whether those sediments can be reliably contained in a different CDF location with entirely different groundwater flow conditions and containment design. A CDF-specific long-term groundwater transport model that describes the CDF design and surrounding environmental conditions must be used to determine sediments that can be effectively contained within that CDF. Such a CDF model was used and extensively reviewed by EPA during the T4 CDF 60% design development. That modeling determined that sediments from ten Site areas with relatively higher contaminant concentrations were suitable for placement in the T4 CDF.

f. The Figure 3.3-40 flow chart appears to expand the restrictions for material eligible for the T4 CDF and is inconsistent with Section 3.3.5.1. Section 3.3.5.1 states the following (page 3-23):

> "Dredged material subject to requirements of a permit that has been issued under Section 404 of the CWA is excluded from the definition of hazardous waste [40 CFR 261.4(g)]. This provision is discussed in the Hazardous Waste Identification Rule (HWIR) (63 FR 65874, 65921; November 30, 1998). Oregon State adopted the HWIR rule in 2003. This rule means that RCRA regulatory requirements do not apply to sediment dredged at the Portland Harbor Site and disposed of on-site, such as at the Terminal 4 CDF, if the material otherwise meets the CDF acceptance criteria."

RCRA regulatory requirements do not apply to sediment that is dredged from the Portland Harbor site and placed on site in a CDF. Similarly, DEQ indicated during the Arkema EE/CA discussions that the state follows the RCRA HWIR. Consequently, dredged sediments containing DDx or other

[14] Per Comment 2, the LWG disagrees that reliably containable material meets the PTW definition at all.

pesticides could also be placed in a CDF, even if it would otherwise be determined to be a state hazardous waste per the Oregon Pesticide Residue Rule.

13. **Incomplete Evaluation of Alternatives –** EPA indicates that the evaluation of alternatives in Section 4 is "qualitative" in some respects. In fact, the evaluation is almost entirely qualitative, and most results and conclusions about the performance of the various alternatives against the FS evaluation criteria are presented as a series of subjective statements. This approach is in stark contrast to the LWG's 2012 draft FS, which contained quantitative and detailed data analyses supporting alternative evaluation methods and results. To illustrate EPA's subjective approach, Table 2, below, provides a comparison of EPA's revised FS Section 4 methods to those used in the 2012 draft FS, often as required by EPA at the time, for each of the seven FS alternatives evaluation criteria.

    EPA summarizes the eight page comparative analysis at the end of Section 4 in Table 4.3-1 by merely condensing the qualitative and subjective statements from the text. This information is further summarized in a dot chart in Table 4.3-2 with the same title as the title of Table 4.3-1, "Summary of Comparative Analysis of Alternatives." Neither the text nor the resulting summary tables address key central questions relevant to the appropriate evaluation of the alternatives against the FS criteria, such as:

    - How does EPA determine that all the alternatives are protective given that EPA's time-zero SWAC analysis indicates that none of the alternatives achieves all of the sediment Remedial Action Objectives (RAOs) and related sediment PRGs? Also, the Section 4 text fails to explain that MNR is not expected to achieve acceptable risk levels indicated by the Section 2 RAOs because, in many cases, those risk levels are below background or equilibrium levels expected for the Site.[15] Therefore, what is the role of background in achieving RAOs and protectiveness in general?
    - How does EPA determine that all alternatives comply with Applicable or Relevant and Appropriate Requirements (ARARs), given that some surface water quality ARARs are not met in upstream river water? What is the role of ARAR waivers in EPA's determination that ARARs will be met?
    - How does EPA determine the relative long-term effectiveness of the alternatives, given that EPA makes only short-term estimates of sediment concentrations (i.e., time-zero SWACs)? Time-zero SWAC-based risk metrics used by EPA to evaluate and compare alternatives against RAOs 1 and 2 indicate that there is marginal, if any, benefit to additional active sediment remediation beyond Alternative B. Similarly, how can the long-term effectiveness related to surface water RAOs be assessed, given no estimates (qualitative or otherwise) are made for long-term surface water and tissue concentrations?

[15] Although a few of the Section 2 PRGs are based on EPA's calculations of background levels (e.g., RAO 2 PCB PRG), the RAOs themselves call for achievement of acceptable risk levels without mention of background conditions.

- How does EPA determine the relative short-term effectiveness of the alternatives, given EPA makes no quantitative estimates of the short-term impacts to water quality or the time until protection is achieved (or other impacts like worker safety)? How can the balance of risks associated with short-term construction impacts and time to achieve RAOs be accurately determined?
- How can the alternative costs be even generally verified as accurate if the methods to calculate the quantities shown are not clearly presented (in either Section 3 or Section 4) and all associated quantities and costs are presented only on an aggregate Site-wide basis?

EPA's sediment guidance (EPA 2005a) addresses the role of quantitative estimates in making these critical decisions:

> "The time needed until protection is achieved can be difficult to assess at sediment sites, especially where bioaccumulative contaminants are present. Generally, for sites where risk is due to contaminants in the food chain, time to achieve protection can be estimated using models. These models may have significant uncertainty, but may be useful for predicting whether or not there are significant differences between times to achieve protection using different alternatives. When comparing time to achieve protection from MNR to that for active remedies such as capping and dredging, it is generally important to include the time for design and implementation of the active remedies in the analysis."

This guidance is particularly relevant for large and complex sites like Portland Harbor where uncertainties are often greater and quantitative estimates help to understand those Site uncertainties and better support appropriate remedy decision-making. For example, EPA Region 10 just recently completed decision-making using such quantitative approaches for the similarly complex Lower Duwamish Waterway site (EPA 2014).

Table 2. Comparison of Alternative Evaluation Methods for EPA's Revised FS Section 4 and LWG's 2012 Draft FS.

FS Evaluation Criteria	EPA's Revised FS Section 4	LWG's 2012 Draft FS
Protectiveness	• "This criterion draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs." See the description of methods under these other evaluation criteria below. • Percent reductions in SWACs, and residual risks for those SWACs, immediately after construction is complete (i.e., "time-zero") for Remedial Action Level (RAL) chemicals are the only quantitative assessments presented. (As noted elsewhere in these comments, time-zero SWACs and risks are not in any way representative of the long-term outcome or overall protectiveness of the alternatives.)	• "The primary information used to make this determination is projected changes in surface sediment, fish tissue, and water column chemicals of concern concentrations derived from model simulations of each comprehensive alternative both during and after construction, and comparison of these projections with the range of sediment remedial goals, target tissue levels, and water quality criteria, respectively, as well as the timeframes to achieve such levels."
	• Unsupported statements are made about protectiveness of riverbank components of the remedy such as: "However, the extent excavation and capping under this alternative may not be sufficient to deal with the extent of the contamination in riverbank soils that may recontaminate the river sediments."	• Riverbanks were not included in the 2012 draft FS, per EPA direction at that time.
Compliance with Applicable or Relevant and Appropriate Requirement (ARARs)	• Descriptions of the alternatives are compared to ARARs summarized in the Section 2 tables.	• Descriptions of the alternatives are compared to ARARs. (ARARs not specifically noted in this table were handled using similar descriptive text in both EPA's Revised FS and the 2012 draft FS.)
	• Unsupported statements are made about the ability to meet water quality ARARs, such as: "Implementation of the alternative in conjunction with adequate upland source control measures over time are not expected to cause or contribute to exceedances of numeric human health and aquatic life water quality criteria and drinking water MCLGs and MCLs."	• "Short- and long-term surface water quality [modeling] projections for each alternative were compared with state and federal surface water quality standards and criteria."
	• An unsupported assumption is made about the ability to meet Oregon Cleanup Laws, such as: "Oregon's risk standards for degree of cleanup for hazardous substances will be met over time through implementation of remedial technologies, ICs, and monitoring."	• "Long-term sediment concentration [modeling] projections for each alternative were compared to potential cleanup value requirements included in this ARAR."
	• "A simplified approach was used that assumed armored	• Appendix M (approximately 400 pages) describes an

FS Evaluation Criteria	EPA's Revised FS Section 4	LWG's 2012 Draft FS
	and reactive caps within shallow water areas and riverbanks would result in unavoidable impacts that would require compensatory mitigation. This approach is presented in Appendix J." Appendix J contains 7 pages of text describing an approach that assumes that each acre impacted is fully functioning and that the function is fully lost due to the dredge or cap activity, which is clearly an incorrect assumption. The text also notes that "a compensatory mitigation framework will be developed."	"equivalency analysis," proposed compensatory mitigation framework, and estimated mitigation required to compensate for unavoidable adverse effects based on the actual existing and proposed habitat functions in areas addressed by each alternative.
	• Compliance with the Endangered Species Act is described as a future process of Biological Assessment (BA) development.	• The LWG submitted a draft BA for EPA consideration under separate cover at the same time as the 2012 draft FS.
	• Compliance with Federal Emergency Management Act flood and wetland regulations is described as a future process of alternative analysis and design.	• "A one-dimensional hydrodynamic model (HEC-RAS) of the Lower Willamette River and Multnomah Channel was used to evaluate compliance of each of the comprehensive alternatives with this ARAR (Appendix Lb)." This modeling was required by EPA at the time.
	• EPA compares Site bulk sediment levels to very conservative Toxicity Characteristic Leaching Procedure (TCLP)-based bulk sediment screening levels and land disposal restriction levels to determine relatively extensive areas of Resource Conservation and Recovery Act (RCRA) hazardous waste.	• Section 5 of the 2012 draft FS compares actual TCLP results to actual TCLP (liquid) criteria and F002 waste requirements to determine a few limited areas of RCRA waste.
Long-term Effectiveness	• The residual risks associated with time-zero SWACs are presented. (As noted elsewhere in these comments, time-zero SWACs and risks are not in any way representative of the long-term effectiveness of the alternatives. EPA defines long-term effectiveness as follows: "The evaluation of long-term effectiveness and permanence evaluation starts at the time RAOs and PRGs are met." The Remedial Action Objectives (RAOs) are mostly not met at time-zero as indicated by EPA's analysis.)	• "The QEAFATE model was used to project the following long-term contaminant concentrations [in sediments, water, and tissue] resulting from implementation of each alternative…"
	• Recontamination potential is evaluated through qualitative statements: "Because contamination within the areas of	• "This evaluation included examination of recontamination potential [using modeling information]

FS Evaluation Criteria	EPA's Revised FS Section 4	LWG's 2012 Draft FS
	construction is either removed, covered or treated in-situ, the overall concentrations of contamination available for resuspension is less than under Alternative A. Thus, there is less potential for contamination from source areas to continue to recontaminate other areas of the site and allow for MNR processes to occur."	at smaller spatial scales and assessed recontamination potential from ongoing known sources (e.g., stormwater, permitted industrial discharges, groundwater, and upstream inputs), along with localized recontamination due to dredging-related resuspension in adjacent areas."
	• Surface and groundwater are evaluated through qualitative statements: "In addition, some of the areas where groundwater contamination is discharging to the river will be capped to eliminate or reduce this discharge, which in combination with lower overall contaminant concentrations in surface sediment will decrease the time needed to achieve RAOs 3, 4, 7, and 8." Stormwater and upstream sources are not addressed.	• For groundwater: "These evaluations used QEAFATE model projections, which incorporated identified groundwater plumes (Appendix Ha, Section 3.2), to assess long-term surface water and sediment quality changes in groundwater discharge areas."
	• The long-term effectiveness of confined disposal facilities (CDFs) is not discussed.	• "The long-term effectiveness of on-Site disposal options included in each alternative was evaluated against the FS CDF Performance Standards (EPA 2010e and LWG 2010a and b; Appendix O) as defined in Section 6.2.9. The evaluations against the performance standards include modeling projections of CDF long-term contaminant isolation effectiveness presented in Appendix Jb."
	• Other aspects of long-term effectiveness (e.g., Adequacy and Reliability of Controls) not listed in this table are evaluated through general descriptions in both EPA's revised FS and the 2012 draft FS.	• Other aspects of long-term effectiveness (e.g., Adequacy and Reliability of Controls) not listed in this table are evaluated through general descriptions in both EPA's revised FS and the 2012 draft FS.
Reduction of Toxicity	• This criterion is evaluated through comparison of the volumes of ex situ treatment and acreages of in situ treatment provided by each alternative.	• The 2012 draft FS evaluates this criterion similar to EPA's revised FS.

FS Evaluation Criteria	EPA's Revised FS Section 4	LWG's 2012 Draft FS
Short-term Effectiveness	• Community protection is evaluated by comparing the quantities and durations of the alternatives and qualitative statements such as: "Construction and operation activities may result in temporary noise, light, odors, potential air quality impacts and disruptions to commercial and recreational river users on both sides of the river. However, the actual duration at any specific location would be less than the overall construction period."	• Community protection is evaluated in a quality of life analysis in Appendix U with separate sections on aesthetics, odors and dust, noise, recreation, traffic, and navigation.
	• Work protection is evaluated through qualitative statements about the alternative durations such as: "Overall, the risks associated with this alternative would be less than for alternatives D though G due to the shorter construction period."	• "Protection of workers during construction of each alternative was assessed using calculated estimates of non-fatal and fatal injuries using incident occurrence rate data in conjunction with the anticipated construction operations associated with each alternative."
	• Environmental impacts and best management practices are discussed through mostly qualitative and non-comparative statements such as "Sediment removal may result in short-term adverse impacts to the river, including: o exposure of fish and other biota to suspended and dissolved contaminants in the water column, temporary loss of benthos and habitat for the ecological community in dredged areas, o increased emissions from construction and transportation equipment." o Environmental impacts associated with CDFs are not discussed.	• Environmental impacts are evaluated through quantitative and detailed analyses including: o "Water quality, recontamination, and downstream transport during construction were evaluated using QEAFATE model projections throughout the Site. Model-projected water column concentrations were compared to water quality criteria and benchmarks, while sediment quality projections were compared to remedial goals and RALs." Appendix U details results. o "The potential impacts of GHG and air pollutant emissions during construction of each alternative were estimated using standard air inventory calculation methods as described in Appendix Ic." o "The potential short-term impacts to water quality from on-Site disposal facility construction and filling for disposal options associated with each alternative were evaluated through review of the FS CDF Performance Standards."
	• Time protection is addressed through comparison of	• "The approximate timeframes required to achieve RAOs

FS Evaluation Criteria	EPA's Revised FS Section 4	LWG's 2012 Draft FS
	construction durations (which do not represent achievement of protection) and entirely unsupported statements, such as: "Following the estimated construction time, Alternative B would take the longest time to meet RAOs and PRGs, as the residual contaminant concentrations would be the greater than Alternative B through G, requiring more time for MNR processed to achieve the RAOs and success would be more uncertain." No quantitative analysis is conducted to support that the time to meet RAOs would be greater for smaller alternatives (see Comments 13 and 14 for more detail). Also, EPA uses time-zero SWACs to assess short-term effectiveness, which, confusingly, is the same metric used to determine long-term effectiveness.	were evaluated by comparing projected changes over time in sediment and tissue COC concentrations projected using the QEAFATE and Food Web Models to the ranges of sediment remedial goals and target tissue levels."
	• EPA's revised FS does not discuss green remediation practices and their potential use at the Site.	• In order to comply with EPA Section 10 requirements to consider green remediation opportunities as a potential means to reduce the environmental footprint of the remedial action, the 2012 draft FS Appendix N (46 pages) reviews current green remediation guidance and policy, identifies green remediation technologies and practices, and evaluates their applicability and feasibility to the remedial alternatives as identified in the 2012 draft FS.
Implementability	• Implementability is assessed through descriptive comparisons of durations and quantities involved with each alternative.	• Implementability is assessed through descriptive comparisons of durations, which the 2012 draft FS demonstrates are directly and proportionally related to the quantities involved with each alternative.
Cost	• Quantitative current-year and net present value cost estimates are included, but are presented only on a Site-wide basis. Quantities or costs related to specific Sediment Management Areas (SMAs) or Sediment Decision Units (SDUs; or any other type of subarea) contributing to overall costs are not presented in any way.	• Quantitative current-year and net present value cost estimates are presented including the cost buildup procedures by subSMA.
	• Details in the cost appendix "pdf" file includes additional details on cost assumptions, all on a Site-wide basis only.	• Details include comprehensive executable Microsoft Excel files down to the subSMA spatial scale.

14. **Unclear and Unsupported Long-Term and Short-Term Effectiveness Evaluations –** As noted above, EPA does not provide quantitative long-term effectiveness estimates and very limited quantitative short-term effectiveness estimates. While the LWG acknowledges uncertainties in numerical estimates of some of the parameters involved (which are clearly described and evaluated through sensitivity analyses in the LWG's 2012 draft FS), there are appropriate methods to address these uncertainties, consistent with EPA guidance and recent EPA FS evaluations at other similar sites, as noted above. For example, The Lower Duwamish Waterway FS had many similar uncertainties, but a more balanced quantitative evaluation included in that FS proved key in those comparative evaluations (AECOM 2012). Dismissing or overly simplifying quantitative estimates of bioaccumulation, sediment transport, natural recovery, and dredging releases in the comparative evaluation of alternatives inappropriately biases the long- and short-term effectiveness evaluations. Specific issues created by EPA's approach include:

    a. EPA clearly defines that, "The evaluation of long-term effectiveness and permanence evaluation starts at the time RAOs and PRGs are met." EPA then relies on time-zero SWACs to estimate residual risks under the long-term effectiveness subsection. Given that time-zero SWACs represent estimated conditions immediately after construction completion, they do not estimate conditions after the RAOs and PRGs are met. EPA states earlier in Section 4 that time-zero SWACs are used because long-term modeling is considered "unreliable," but this does not explain how time-zero estimates are in any way relevant to evaluation of the criterion.

    b. EPA then uses the same time-zero SWACs to also evaluate the short-term effectiveness of the alternatives. Therefore, there is no differentiation between the metrics used to evaluate the long- and short-term effectiveness criteria. Again, EPA does not discuss how the same time-zero estimates can be used to evaluate both timeframes.

    c. Because time-zero SWACs do not represent long-term outcomes, EPA only provides a "qualitative" (i.e., highly subjective) discussion of the actual expected long-term outcomes for the alternatives. For example, EPA assumes that RAOs not met at time-zero will be met over some unknown amount of time due to MNR. However, acceptable risk levels defined in the Section 2 RAOs are often below background or equilibrium levels expected for the Site. EPA does not discuss how it is envisioned that all the acceptable risk levels below background could possibly be met over time through MNR.

    d. EPA describes the ability to estimate natural recovery and long-term outcomes of the alternatives as highly uncertain. Yet EPA asserts that the smaller alternatives (i.e., Alternatives B and D) will not achieve the RAOs as quickly as the larger alternatives (i.e., E, F, and G). Given EPA's stated concerns about predicting the uncertainties associated with the pace and timeframe of natural recovery, it is entirely unclear how EPA reaches this conclusion. A simple analysis of the alternative construction durations and the best available empirical estimate of the pace of natural recovery shown in Table 3, below, clearly illustrates that EPA's conclusions are unsupported.

The upper half of Table 3 presents EPA's construction durations and the LWG's best estimate of natural recovery rates (expressed as a half-life of 10 years) based on the observed decline in smallmouth fish tissue PCB concentrations sampled over the period from 2002 to 2012 (i.e., using empirical data, not modeling estimates; Anchor QEA 2013). The table shows that Alternatives B through F would all be expected to achieve PCB SWACs equivalent to Alternative G (within the margin of EPA-accepted analytical variability) by or before the time that Alternative G construction could be completed. Further, Table 3 does not include estimates of natural recovery between now and the start of construction (which is "Year 1" in the table). The best-case scenario for the first year of construction would be at least 2022 (assuming ROD in 2017, Consent Decree in 2019, and RD approvals in 2021). This means that natural recovery will have taken place for an additional 7 years before construction starts on any of these alternatives, and this time to start construction is conservatively *not* included in the Table 3 estimated SWACs. Thus, EPA cannot necessarily conclude that Alternatives G will achieve RAOs quicker than the smaller alternatives, as EPA indicates in Section 4.

The lower half of Table 3 presents the same comparison assuming a 12 hours/day construction schedule, instead of EPA's assumption that construction will proceed 24 hours/day. The LWG has strongly disagreed that a continuous 24 hours/day construction schedule over many years is a reasonable expectation for this Site. Again, the assumption is that no natural recovery takes place between now and the start of construction in at least 2022, which is very likely to be incorrect. Thus, considering the uncertainty of EPA's aggressively fast construction durations, the lower half of Table 3 shows that it is even less likely that larger alternatives (e.g., F and G) would achieve RAOs any quicker than the smaller alternatives.

The Table 3 analysis is simplistic and is not a complete evaluation of the time to achieve RAOs, such as provided in the 2012 draft FS using the QEAFATE modeling approach. For example, the pace of natural recovery would be expected to be faster than indicated in Table 3 because these calculations do not include estimates of natural recovery before or during the construction period. Further, EPA would likely argue that the half-life of 10 years assumed is highly uncertain, while the LWG would argue that the ability to construct these alternatives within EPA's estimated durations is highly uncertain. Consequently, Table 3 is not intended to represent the best interpretation of time to meet RAOs for the Site. Rather, Table 3 illustrates, using EPA's information and stated concern about evaluation uncertainties, that EPA's conclusions regarding larger alternatives meeting the RAOs more quickly are based on unsupported assumptions. Even a simple quantitative analysis, such as Table 3, is sufficient to show the bias in EPA's conclusions in light of the recognized uncertainties regarding the short- and long-term effectiveness of the alternatives.

Table 3. Illustration of the Implications of the EPA Recognized Uncertainties in Predicting Time to Achieve RAOs.

PCB SWACs (ppb) Comparison Using EPA's 24-hour/day Assumption for Alternative Durations

Best Estimate Natural Recovery Half Life (yrs)* = 10

EPA Alternatives	Years**																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A (no action)	85	79.1	73.6	68.5	63.8	59.4	55.2	51.4	47.9	44.5	41.4	38.6	35.9	33.4	31.1	28.9	26.9	25.1
B				49.3	45.9	42.7	39.7	37.0	34.4	32.0	29.8	27.8	25.8	24.0	22.4	20.8	19.4	18.0
D					40.0	37.2	34.6	32.2	30.0	27.9	26.0	24.2	22.5	20.9	19.5	18.1	16.9	15.7
E							31.5	29.3	27.2	25.4	23.6	22.0	20.4	19.0	17.7	16.5	15.3	14.3
F												21.3	19.8	18.4	17.1	15.9	14.8	13.8
G																		15.3

PCB SWACs (ppb) Comparison Using LWG's 12-hour/day Assumption for Alternative Durations

EPA Alternatives	Years**																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A (no action)	85	79	74	69	64	59	55	51	48	45	41	39	36	33	31	29	27	25	23	22	20	19	18	16	15	14	13	12	11	11	10	9	9	8	7	7
B								49	46	43	40	37	34	32	30	28	26	24	22	21	19	18	17	16	15	14	13	12	11	10	10	9	8	8	7	7
D										40	37	35	32	30	28	26	24	23	21	20	18	17	16	15	14	13	12	11	10	10	9	8	8	7	7	6
E														32	29	27	25	24	22	20	19	17	17	15	14	13	12	12	11	10	9	9	8	8	7	7
F																								21	20	18	17	16	15	14	13	12	11	10	10	9
G																																				15

	Duration of alternative construction
XX	Year construction is completed and EPA estimated SWAC at that time.
XX	Year that alternative achieves the Alternative G post-construction SWAC, plus 20% (i.e., plus or minus 20% is the EPA acceptable analytical accuracy for organic compounds) using estimated natural recovery rate.

* Estimated natural recovery rate based on average smallmouth bass fish tissue half-lives using 2002, 2007, and 2012 data. Recent 2014 PCB sediment data appear to be approximately equivalent to this half-life.

** The years start at the assumed start of construction. The best-case scenario for the first year of construction would be at least 2022 (assuming ROD in 2017, Consent Decree in 2019, and RD approvals in 2021). This means that natural recovery will have taken place for an additional 7 years before construction starts on any of these alternatives, and this time to start is conservatively not included in the above estimated SWAC reductions.

e. As discussed in Comment 13, EPA makes no quantitative evaluations of short-term effectiveness for worker protection, air emissions, water quality impacts, or time to achieve protection (e.g., time to achieve the RAOs). (As shown in Table 2, the 2012 draft FS contains well-accepted, guidance-based methods to quantitatively estimate all of these impacts, but EPA chose not to use any of these tools.) Thus, there is no way for EPA to actually evaluate the balance of the construction impacts and time to achieve RAOs. For example, because dredging water quality and other construction impacts are expected for a duration of up to at least 18 years (for Alternative G using EPA's estimates), how much quicker do the RAOs need to be met to justify those impacts? If the dredging water quality impacts (and associated impacts to fish tissue concentrations) are estimated as very significant, the achievement of RAOs by a more construction intensive alternative needs to be much quicker than other alternatives to justify those significant water quality impacts. An entirely different conclusion might be reached if the dredging water quality impacts are estimated to be minimal for 18 years. But EPA makes no quantitative estimates of the magnitude of water quality impacts, despite the ready availability of commonly applied ERDC dredge water quality models such as the DREDGE model (ERDC 2015). Consequently, EPA's conclusions regarding the balance of short-term effectiveness across these overall impacts are unsupported and completely subjective.

f. EPA's short-term impacts evaluation (impact on community, workers, and environment) consists of making unsupported subjective statements about these likely impacts. EPA's evaluation fails to meet CERCLA requirements, which states, "The potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment," must be evaluated during remedy selection. See 42 U.S.C. § 9621(b)(1)(G). Additionally, 40 CFR 300.430(e)(9)(iii)(E) requires that an FS evaluate the following: short-term risks that might be posed to the community during implementation of an alternative, potential impacts on workers during remedial action and the effectiveness and reliability of protective measures, and potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.

   Although Section 4 includes some general statements about these short-term impact issues, this does not fully address the regulatory requirements noted above. Rather, EPA often assumes negative impacts generated by the project will be controlled or eliminated during implementation through BMPs or similar measures (e.g., particularly with regard to dredging releases). A quantitative analysis of short-term risks is an essential element of a defensible FS. As the LWG has demonstrated in its 2012 draft FS, using available occupational and actuarial data, the worker risks generated by implementing each alternative can be predicted with greater certainty than the risks predicted from long-term exposure to sediment. For example, each truck trip to the proposed disposal facility generates over 1×10^{-6} risk of a fatality. Also, as discussed in Comment 5a, EPA does not assess community impacts at a reasonable level of detail.

15. **Inappropriate Benthic Risk Analysis –** EPA does not mention benthic community risks in the Section 3 RAL, SDU, or SMA development text (as noted in Comment 3). EPA must develop and evaluate alternatives that fully consider benthic risks using methods that are consistent with the BERA. Although EPA conducts an extensive SDU analysis to assess whether the selected RALs bound other risk pathways, EPA does not discuss the extent to which these RALs are expected to bound and address benthic community risks. In contrast, the 2012 draft FS included a detailed evaluation of and determination of benthic risk SMAs using the CBRA approach, as required by EPA at the time.

    Then in Section 4, EPA evaluates the alternatives for their ability to adequately address benthic community risks. EPA concludes that all the alternatives do not address through active remediation a "substantial" portion of the benthic community risks. For example, EPA states for Alternative G, "There are a substantial number of locations where unacceptable benthic risk (identified via bioassays or predicted via the Logistic Regression Model [LRM]) are not encompassed by the areas of construction as shown on Figure 4.2-11." EPA states that the remaining benthic risks will be addressed through MNR. While it is reasonable to address low-level risks through MNR (including benthic risks), EPA has constructed alternatives that ignore benthic risk and then demerits those same alternatives in the effectiveness evaluation for failing to adequately address benthic risks.

    EPA's benthic risk approach is particularly inconsistent given that EPA made multiple changes to the RALs between the draft and revised FS because EPA deemed the 2012 draft FS RALs for PAHs, DDE, and dioxin/furans as "not protective." This decision resulted in extensive work to recalculate all the SMAs and alternative quantities and costs. EPA does not attempt to explain in Section 4 whether EPA could have avoided all of this rework and instead similarly decided that MNR would address relatively low-level risks for PAHs, DDx, and dioxin/furans that EPA deemed were not directly addressed by the 2012 draft FS RALs. There are some important additional technical issues with EPA's benthic risk approach as follows:

    a. EPA's method for defining benthic risks requires additional explanation. EPA provides one figure series (Figure 4.2-11 and Figures 4.2-14 through 17) and two statements regarding the methods used: 1) "Identified via bioassays or predicted via the LRM"; and 2) "Additionally, benthic risk is evaluated by determining the percentage of measured or predicted benthic toxicity points addressed by the construction of the alternative." The term "toxicity points" is new and not defined. Consequently, these results are not reproducible and the subsequent, related conclusions appear unsupported.

    b. From examination of the cited figures, it appears that EPA used any instance of a Level 2 or Level 3 bioassay hit and any exceedance of the LRM benthic screening levels to determine that "benthic risk" was present at any given sampling station. The BERA is clear that individual benthic toxicity lines of evidence are insufficient to fully characterize benthic risks at the Site.

Therefore, EPA's "toxicity points" methodology appears inconsistent with the EPA-approved BERA. This is despite EPA indicating that risks were evaluated in Section 4 "consistent with the BERA." Further, the BERA is clear that the LRM screening levels are relatively poorly correlated with observed toxicity as compared to the FPM model. EPA provides no justification for focusing on the LRM screening levels rather than other available screening levels from the BERA. Further, EPA appears to not be using the EPA-proposed benthic toxicity PRGs from Section 2, which EPA indicates in Section 2 determine attainment of RAO 5.

16. **Inappropriate Cost Estimates –** EPA's costs estimate methods and results are insufficiently detailed to support the FS evaluations and consistently minimize the apparent costs of the larger alternatives and dredging, as compared to the smaller alternatives and capping. Given the lack of supporting information and the compounding effect of the many errors and inconsistencies with the limited information that is provided, it appears highly unlikely the overall cost estimates would achieve the +50% to -30% precision required by EPA FS costing guidance (EPA 2000).

    a. Section 3 does not contain any details on the development of alternative quantities, such as areas, dredge volumes, and placed material volumes (e.g., caps and backfills), and as noted in the Section 3 significant issues, the total quantities that are provided are often inconsistent in various text and table locations, sometimes with variations in excess of 100%. Given that much of the alternative costs are developed using unit costs (i.e., dollar cost per unit of quantity), understanding the process steps and accuracy of quantity estimates represents half of the typical costing procedure but is almost completely undescribed.

    b. The cost estimates for each alternative are presented on a Site-wide basis only, with no spatial differentiation within the Site. It is impossible to determine the subareas (such as SMAs or SDUs) within the Site from which quantities or costs originate. In contrast, the 2012 draft FS contained detailed executable Excel spreadsheets that showed the "build up" of the costs starting from a subSMA spatial scale.

    c. Overall, EPA's cost estimates are much higher than the alternatives presented in the 2012 draft FS, but the additional effectiveness and protectiveness provided by these additional expenditures is entirely unclear for reasons discussed in Comments 13 and 14 above. Further, EPA has substantially and proportionally increased the costs of the smaller alternatives, as compared to the larger alternatives. For example, EPA's Alternative B Net Present Value (NPV) cost estimate is 2.4 to 4.7 times more expensive than the 2012 draft FS Alternatives B-i and B-r, while EPA's Alternative G NPV cost estimate is 1.4 to 2.8 times more expensive than the 2012 draft FS Alternatives F-i and F-r. Thus, as compared to the 2012 draft FS, the costs of EPA's smaller alternatives have increased by approximately 70% more than the cost increases associated with the larger alternatives. EPA's Alternative B NPV cost is now approximately $791 million (Table 4.3-1), as compared to the

2012 draft FS Alternative B range of $169 to $330 million. And EPA screens out Alternative C entirely in Section 3, so the next EPA alternative is Alternative D at an NPV cost of $1.1 billion. As a result, there is no longer any reasonably defined “low cost alternative” to support evaluation of a wide range of potentially cost-effective remedies for the Site.[16]

d. Appendix J (Compensatory Mitigation Requirements), Section J3.2 (FS Mitigation Assumptions and Cost Evaluation) describes the simplified approach that was used to determine the extent of mitigation that could be required under each alternative and to develop potential mitigation costs. The approach includes totaling acreages of shallow water and river bank areas with cap and dredge technology assignments that are then multiplied by a unit cost (per acre) for mitigation.

   This approach assumes that each acre impacted is fully functioning and that the function is completely lost due to the dredge or cap activity. This is not a reasonable assumption given that most shoreline and bank areas in the harbor are degraded and provide limited habitat function and value (e.g., presence of contaminants, steep slope, and limited riparian area). Therefore, all of the mitigation costs provided are likely conservatively high. This approach yields large dollar amounts for mitigation across the alternatives ($32 million to $382 million over 14 to 163 acres). During design when actual existing and proposed habitat conditions are considered, the actual mitigation needs will likely be significantly lower.

e. EPA increased some cost assumptions for capping, which favor making capping more expensive relative to dredging. (By contrast, as discussed in Comment 16f below, EPA minimizes the costs of many aspects of dredging.) EPA increased cap placement and material purchase costs 35% above the 2012 draft FS unit rates with no explanation. Similarly, EPA increased armor placement and material purchase by 83% with no explanation.

f. Despite adjusting the overall range of costs substantially upward, EPA appears to also be using a number of assumptions that make the larger and dredging-intensive alternatives appear optimistically less costly. Examples include:

   i. EPA used a 7% discount rate, which is indicated on the first page of EPA cost estimate guidance for FSs (EPA 2000). However, the second complete paragraph on page 4-5 of that guidance indicates that a different discount rate can be used as long as it is justified consistent with OMB Circular A-94. Accordingly, the 2012 draft FS used a discount rate of 2.3%, consistent with guidance as explained in that document. The equivalent treasury rate for 2015 is 1.4%, which is a much more appropriate discount rate at a site where the PRPs include the

[16] This is particularly true given that the 2012 draft FS concluded that Alternative B was the most cost-effective alternative, and EPA has not shown in the revised FS why this conclusion is false for reasons stated in Comments 13 and 14.

United States, the State of Oregon, municipalities, public utilities, and many parties whose principal or only source of funding for cleanup are insurance funds outside their investment control. The effect of EPA's higher discount rate is that the larger alternatives with greater construction durations are heavily discounted (i.e., Alternative E is discounted a total of 41% and Alternative G is discounted by 77%).

ii. EPA used an unexplained mobilization/demobilization factor of 1.6%, while the 2012 draft FS used 15% factor based on project experience at similar sites.

iii. EPA used a contingency factor of only 20%, while the 2012 draft FS used 40%. EPA guidance indicates that the overall contingency for an FS should be in the 20 to 45% range. Thus, EPA is using the lowest possible contingency factor allowed by guidance. EPA cites guidance indicating that larger projects with high costs may have lower overall contingency factors. This may be true for some types of projects, but given the complexity of this Site and the large number of issues that will be refined in design, using the lowest possible contingency factor appears very optimistic and greatly decreases the costs of the alternatives, particularly the largest alternatives.

iv. EPA used lower percentages for Project Management (2%), Remedial Design (2%), and construction management (3%) than EPA guidance (5%, 6%, and 6%, respectively). These factors are also lower than the 2012 draft FS, which used 15% for remedial design and a monthly rate for project management and construction management.

v. EPA used a 1.75 factor times the "neat" volume to obtain total volumes for each alternative (average of the 1.5 to 2.0 range indicated by EPA). The 2012 draft FS approach included specific factors applied to actual FS-level dredge prisms to estimate overall volumes, whereas EPA's simplistic neat volume approach sets a depth for each 10 × 10-foot "pixel." EPA's approach underestimates dredge volumes, as the LWG has previously commented (LWG 2014a). Consequently, EPA's volume factor of 1.75 is optimistically low.

vi. EPA is assuming a 140-acre offloading facility will be developed somewhere on the river, as compared to the 2012 draft FS assumption of a 20-acre facility. EPA then assumes the same development costs for this facility as the 2012 draft FS, despite EPA's assumed facility being 7 times larger. (EPA adjusted some other facility costs to partially account for this much larger facility.)

vii. EPA assumes that all dredge dewater must be treated at a dedicated water treatment facility before discharge to the river. This will require extremely robust and costly treatment methods to meet low water quality criteria and state standards. However, EPA includes no water treatment costs for water generated during dredging. Even typical environmental dredging practices create large volumes of dewater. Further, EPA also assumes widespread use of an articulated arm bucket, which generates relatively greater amounts of water (i.e., approximately a cubic yard of water will be generated for each cubic yard of dredge material). Consequently, the absence of water treatment costs is a significant omission in the cost estimates.

viii. EPA conducted a cost sensitivity analysis, although it does not appear to be used in the main text of Section 4. The sensitivity analysis does not vary many of the factors that are expected to contribute most to variations in costs (some of which are described above). Also, there are several aspects of the sensitivity analysis that are incorrect or represent impossible situations not reflective of actual cost variations. For example, EPA varies alternative durations without varying the associated capital costs. EPA also varies the volumes by small factors without varying the resulting construction durations. Consequently, the sensitivity analyses do not represent a reasonable evaluation of whether EPA's cost estimates are within the guidance requirement of +50 to -30% precision.

g. There are significant equipment and contracting issues associated with executing multi-year projects where tens of millions of dollars of equipment need to be mobilized to the Site. The cost estimates do not factor in the standby costs created by idle equipment for two thirds of each year while the construction window is closed.

h. Other aspects of EPA's FS methods that appear to underestimate costs that are noted in other comments include:

i. Optimistic construction durations reduce costs related to labor or equipment time.

ii. Volumes, and therefore associated removal costs, appear likely to be underestimated.

iii. The cost impacts related to use of innovative and extensive techniques to reduce dredge releases do not appear to be considered.

17. **Risk Inconsistency –** EPA's methods and results are often inconsistent with the BLRAs throughout the FS including Sections 2, 3, 4. This culminates in Section 4 with a residual risk assessment that departs significantly from the methods and findings of the BLRAs. The LWG has commented to EPA on numerous occasions (e.g., LWG 2014d, 2015a, 2015b) that EPA should include risk management steps in the FS consistent with guidance. These comments include that EPA should address only those potential risks for contaminants, media, and pathways that were clearly found to pose unacceptable risks in the BLRAs and that EPA should further focus on the subset of unacceptable risks that are required for selecting an effective and protective remedy using all of the FS criteria. Instead, EPA has departed from the BLRAs and applied virtually none of the risk

management steps noted in guidance such as the 2005 sediment remediation guidance and EPA's 11 Risk Management Principles Memorandum for, "making scientifically sound and nationally consistent risk management decisions at contaminated sediment sites." The relevance of this guidance to risk management steps in the FS is reviewed in detail in Sections 10.1 and 10.2 of the 2012 draft FS. In summary, EPA guidance (2005a) discusses "Risk Management Principles and Remedial Approaches" and clearly describes that the cleanup should use a "risk-based framework"; "select site-specific, project-specific, and sediment specific risk management approaches that will achieve risk-based goals"; and "ensure that sediment cleanup levels are clearly tied to risk management goals" (p. 1 – 5).

Specific issues related to EPA's lack of consistency with the BLRAs, residual risk assessments, and lack of risk management include:

a. Per the LWG's 2014 Section 2 comments (LWG 2014d) and consistent with law, EPA guidance, and precedents from other sediment sites as detailed in past comments:

   i. RAOs, COCs, and PRGs should only be designated for contaminant exposure scenario pairs (ecological or human health receptors and pathways) for which the EPA-approved BLRAs identified potentially unacceptable risk from in-river media (e.g., not potential upland source media, and ARARs should not be used to develop PRGs for non-COCs).

   ii. PRGs should be established and applied for these COCs consistent with risk assessment methods (e.g., spatial scales) and only where sufficient technically valid information exists to do so.

   iii. The FS should focus on those COCs and PRGs that are technically practicable to achieve and for which acceptable risk levels can be reached through the sediment remedial action alternatives being evaluated in the FS.

   iv. COCs and PRGs should only be established if reasonably conservative risk management approaches indicate that a contaminant is significantly contributing to risk and that evaluation of remedial alternatives with respect to a PRG for a particular COC/exposure pathway pairing is required in order to select a protective remedy.

   v. Consistent with EPA background guidance (EPA 2002), PRGs should not be set below reasonably achievable anthropogenic background levels (this includes the concept of "equilibrium" as explained in LWG 2014g).

   The LWG's Section 2 comments (LWG 2014d) detail how each of these concepts is consistent with remediation regulations and guidance.

b. Similarly, RALs for each COC should be applied consistent with the exposure and potentially unacceptable risk areas defined for that COC in the BLRAs (e.g., RALs should not be applied where the exposure pathway or unacceptable risks for those COCs do not currently exist). This is consistent with the "risk-based framework" required by guidance, as cited above. The issue of RAL consistency with the BLRAs is also noted in the Comment 3.

c. EPA presents a residual risk evaluation in Section 4 and indicates that the risks were calculated using methods consistent with the BLRAs. No details are provided on how the risk calculations where performed. Appendix H is entitled "Residual Risk Evaluation," but this appendix only contains a brief description of how time-zero SWACs were estimated on a rolling river mile basis. Additional information on the exposure assumptions, exposure point concentrations (for both sediment and tissue), and toxicity values is needed to evaluate consistency with the BLRAs. EPA's statement of consistency with BLRA methods is not enough to ensure that the methods are fully understandable or reproducible. Regardless, even based on the limited information presented, it is clear that EPA's methods are not consistent with the BLRAs in at least several respects. Examples include:

   i. For human health sediment direct contact, time-zero SWACs were generated for shoreline areas (excluding the navigation channel) on a 1-river mile spatial scale, according to Appendix H. (However, the main text indicates instead that 0.5 river mile spatial scales were used. Also, Figure 4.2-1 suggests that EPA included the navigation channel in RAO 1 assessment, which would be incorrect.) Regardless, of how EPA actually did the assessment, sediment direct contact risks were evaluated in the BHHRA for shoreline *half* river miles, excluding the navigation channel.

   ii. For human health fish consumption risks, SWACs were generated on a 1-river mile basis longitudinally split into the two shoreline areas and the navigation channel. However, in the BHHRA risks were evaluated by whole river miles with no longitudinal splitting for recreational fish consumption. Further, it is unclear which fish consumption scenario is actually being presented in the residual risk figures. If the subsistence fisher scenario is being presented, this was evaluated on a Site-wide basis in the BHHRA (not by river mile). The text on page 4-6 indicates that EPA calculated tissue concentrations from the SWAC estimates, but no tissue concentrations are presented. The text also indicates that these estimated tissue concentrations were compared to the PRGs for RAO 2. The LWG indicated in the Section 2 comments (LWG 2014b, 2015a, 2015b) disagreement with several aspects of EPA's tissue PRG calculations (and that such tissue levels should be classified as PRGs at all) because EPA was not consistent with the BHHRA methods.

   iii. The human health residual risks for Alternative A are higher than the maximum risks calculated in the BHHRA, which indicates there are inconsistencies (residual risks should not be higher than baseline). The highest non-cancer risk for a breastfeeding infant in the BHHRA was 10,000. The residual risk assessment indicates the highest non-cancer risk for a breastfeeding infant would be 210,000.

iv. There is a significant disconnect between the BHHRA and residual risks for RAO 2 for dioxins/furans. For a breastfeeding infant, the highest hazard quotients for dioxin/furan TEQ calculated in the BHHRA were 10 on a Site-wide basis (tribal fish consumption, whole body diet) and 10 on a river-mile basis (recreational RME consumption, RM 7). Figure 4.2-4c(1) indicates that the HQ from HxCDF alone (not the entire TEQ) is more than 14,000 for Alternative A. For a child, the highest hazard quotients for dioxin/furan TEQ calculated in the BHHRA were also 10 on a Site-wide basis (tribal fish consumption, whole body diet) and 10 on a river-mile basis (recreational RME consumption, RM 7). Figure 4.2-3f(1) shows a HQ greater than 30 for just HxCDF. The RfD has changed since the BHHRA was completed, but that does not account for the difference between the BHHRA and residual risks.

v. Continued exclusion of the site use factor from the BHHRA for BaPEq RAO 1 PRG (106 µg/kg) results in concluding that not even Alternative G will result in SWACs meeting the PRG at time zero in east and west river miles (per EPA's Table 4.2-1). However, if the BHHRA site use factor is accurately applied to this PRG (424 µg/kg), Alternative A appears to achieve RAO 1 in all East RMs (according to EPA's Figure 4.2-7b).

vi. Residual risk figures should show and Section 4 should discuss human health risks compared to a 10^{-4} threshold in addition to the 10^{-6} threshold to fully evaluate the range of effectiveness. EPA's Section 2 presents PRGs calculated on both a 10^{-4} and 10^{-6} thresholds. EPA should evaluate alternatives in the entire acceptable risk range (10^{-4} to 10^{-6}) against the FS evaluation, not just variations of RALs all targeted at 10^{-6} or lower risk.

vii. For ecological sediment direct contact, SWACs were generated on a 0.2-mile basis with longitudinal splitting. This spatial scale may or may not be representative of the combined lines of evidence approach used in the BERA to assess benthic risks, given areas of benthic risk were defined for various sized clusters of sampling stations. Further, the hazard quotients presented in the figures appear to be generated by simply dividing the SWAC by the individual PRGs in Section 2, which are mostly based on generic literature Probable Effects Concentrations (PECs). The LWG has already commented on Section 2 (LWG 2014b, 2015a, 2015b) that use of the individual PECs is not consistent with the BERA determinations of benthic risks using multiple lines of evidence.

viii. For ecological bioaccumulation risks, SWACs were generated on a 1-river mile basis with longitudinal splitting. However, the receptors that appear to be used in the residual risk calculations were evaluated over various exposure spatial scales. For example, osprey egg assessment appears to be the receptor of choice for dioxin/furans and DDE, and osprey exposure was assessed in the BERA on a much larger spatial scale than 1 river mile. Thus, it is unclear how EPA's one spatial scale assessment can be consistent with all of these various BERA assessments. Further, the LWG has already commented for Section 2 that some of the receptors EPA focuses on for RAO 6 PRG development, and EPA presumably is focusing on for this residual risk assessment, are inappropriate and inconsistent with the BERA for reasons detailed in those past comments (LWG 2014b, 2015a, 2015b).

ix. The statement in Section 4.1.6.1 that "ecological hazard quotients are calculated using the estimated sediment concentrations and the risk-based PRGs for RAOs 5 and 6, consistent with the process used in the BERA" is misleading in its claim that RAO 5 and 6 PRGs are risk-based. The assertion that this EPA process used to calculate ecological hazard quotients is consistent with the BERA is obviously wrong because ecological hazard quotients that EPA reports in Section 4.2.1 for alternative A (no action) are much higher than BERA HQs. The residual risk assessment is also apparently inconsistent with the BERA in its use of "ecological hazard indices," although this is unclear because EPA has not defined the term.

x. The residual ecological risk assessment is inconsistent with the BERA in asserting that riverbank soil poses risk. No analysis is provided to back up this assertion and no analysis of riverbank soils (as defined in the RI) were assessed in the BERA.

xi. Despite EPA providing few method details, these aspects of EPA's residual risk methods can be shown to be inconsistent with the BLRAs. This suggests it is highly likely that other details of the methods, if they were known, would also be inconsistent with the BLRA methods.

18. **Inappropriate Resource Conservation and Recovery Act and Other Waste Determinations –** Sections 3 and 4 present several determinations regarding RCRA hazardous waste and the Oregon Pesticide Residue Rule that are inconsistent between sections or incorrect. These include:

   a. The LWG disagrees with EPA's assumptions regarding the potential designation of sediments offshore of the Arkema site as State-listed wastes under the Oregon Pesticide Residue Rule. This designation was disputed by LSS during the Arkema EE/CA, and EPA has yet to resolve this issue with DEQ. EPA's interpretation of the Oregon Pesticide Residue Rule will not be resolved through further testing, as suggested by Section 3.3.5.1 in the FS: "Appropriate testing will need to be conducted to determine if sediment removed from the approximate areas shown on Figure 3.3-39 contains these listed RCRA- or State-listed wastes."

   b. EPA indicates that there is RCRA hazardous waste in sediment off of the Arkema Site due to chlorobenzene (see Fig.4.2-2d). (Incidentally, the green area shown in this figure is not the highest sediment concentration for chlorobenzene in this area. Consequently, it is unclear how EPA arrived at the green area noted in the figure.) During the Arkema EECA characterization work, 15 cores were obtained from the area of highest sediment contamination (between the docks) and run for a full TCLP analysis. Regarding chlorobenzene, in order for it to be a characteristic (toxicity) hazardous waste, it would have to exceed 100 mg/L chlorobenzene Toxicity Characteristic Leaching Procedure (TCLP) level. The highest TCLP concentration result for chlorobenzene in the EE/CA sampling was 22 mg/L, and the average was less than 5 mg/L. Therefore, it is technically incorrect for EPA to designate any sediment off the Arkema Site as characteristic hazardous waste based upon the presence of chlorobenzene.

c. Page 4-23 presents additional EPA determinations beyond those presented in Section 3 regarding RCRA waste determinations. EPA indicates in Section 4 that TCLP bulk sediment screening levels are used to determine likely RCRA hazardous wastes. However, Section 3 indicates that actual TCLP (leachate liquid) results are used for RCRA hazardous waste determinations. In general, it is inappropriate to use bulk sediment TCLP screening levels for determinations of hazardous waste, even at an FS level, particularly when an extensive set of actual TCLP results are available. The primary reason is that the bulk sediment screening levels assume that all of the chemical present in the bulk sediment will be leached out during the TCLP test. This is almost never the case, so such screening levels are as conservative as possible. Also, the FS TCLP data were collected under an EPA-approved field sampling plan. EPA provides no rationale for why bulk sediment screening levels are used in Section 4 instead of the EPA-directed TCLP results used in Section 3.

d. EPA appears to use RCRA Land Disposal Restriction (LDR) values to identify large areas of soil and sediment that must be treated prior to disposal if excavated or dredged. Section 4.2.2.2 (page 4-23) states, "Waste will also be sampled as generated to determine any volumes that exceed Land Disposal Restrictions (LDRs) and will require the prescribed treatment prior to disposal. LDR values have been established for 39 COCs as shown in Table 4.2-11. The RI data set indicates that 32 COCs exceed the criteria. The locations where these criteria are exceeded is presented on Figures 4.2-13a-e." We read this text and the referenced table and figures to suggest that all dredged sediments with concentrations exceeding the values on Table 4.2-11 must be treated prior to disposal.

   RCRA land disposal restrictions apply only to RCRA "hazardous wastes." 40 CFR §268.1(b): "The requirements of this part apply to persons who generate or transport hazardous waste." "To be subject to the land disposal restrictions, a waste must first be a RCRA hazardous waste. Unless a waste meets the definition of a solid and hazardous waste, its disposal will not be subject to the LDR program." *Introduction to Land Disposal Restrictions*, p. 5 (EPA530-8-05-013, September 2005). *See also, Management of Remediation Waste Under RCRA*, p. 2 (EPA530-F-98-026, October 14, 1998) ("Note that not all remediation wastes are subject to RCRA Subtitle C hazardous waste requirements. As with any other solid waste, remediation wastes are subject to RCRA Subtitle C only if they are listed or identified hazardous waste. Environmental media are subject to RCRA Subtitle C only if they contain listed hazardous waste, or exhibit a characteristic of hazardous waste.") Many of the LDR values identified in Table 4.2-11 are well below DEQ risk-based cleanup values for residential soil, and non-RCRA hazardous waste remediation wastes can safely be managed in Subtitle D landfills without prior treatment.

i. EPA's Section 3 presents only one instance of TCLP results indicating toxic hazardous waste (near Arkema) and another instance of a TCLP exceedance at Gasco, where EPA notes that MGP wastes are "by definition not RCRA hazardous wastes per 40 CFR §261.24(a)." EPA notes two specific and spatially limited instances of potential listed waste. Other than in these limited areas, RCRA LDRs are not even potentially applicable and should not be considered in the FS or in remedy selection. See *Management of Remediation Waste Under RCRA* (p. 6): "If hazardous waste was originally disposed of before the effective dates of applicable land disposal restrictions and media contaminated by the waste are determined not to contain hazardous waste when first generated (i.e., removed from the land, or area of contamination), the media are not subject to RCRA requirements, including LDRs."

ii. Although there are no references for the LDRs identified on Table 4.2-11, the values appear to be the Universal Treatment Standard (UTS) values found in 40 CFR 268.48 Table UTS. Where LDRs may be applicable at this Site because of the presence of listed or characteristic RCRA wastes, 40 CFR §268.49 provides alternative treatment standards for soil (including sediment) containing hazardous waste. Generally, 40 CFR §268.49 requires that soil containing a listed hazardous waste or exhibiting the toxicity characteristic of hazardous waste must be treated prior to land disposal to remove 90% of the underlying hazardous constituent concentrations or to 10 times the UTS, whichever would be achieved first. That is, the LDR values in EPA's table are low by a factor of at least 10.

EPA's disposal decision tree (Figure 3.3-40) indicates that RCRA hazardous waste will be ex situ treated and then disposed of in a Subtitle C landfill. But the cost appendix (G) makes no mention of any treatment or disposal requirements and associated costs assumed for RCRA hazardous waste. Consequently, it is unclear whether EPA actually included in any alternatives an assumption of ex situ treatment and Subtitle C disposal any of the potential RCRA hazardous waste discussed in Sections 3 and 4.

19. **Low Level of Detail, Clarity, and Consistency** - EPA does not present intermediate details that lead to many of the estimates made in Section 3 (e.g., quantities, durations, locations of various Site or alternative features, etc.). Also, many alternative requirements are simply stated with little or no explanation of the reasoning behind the

choices involved. Further, many aspects to EPA's descriptions are inconsistent between locations in the text, between text and figures, or between text and tables. This makes the overall approach difficult to understand, and it is not currently reproducible even to a general degree.

Some examples of the inconsistencies and missing information in Section 3 include (but are not limited to):

a. EPA does not explain how the PTW highly toxic thresholds were derived. EPA orally referred at the July 29, 2015 roll-out meeting to a 2014 EPA Technical Memorandum. The memorandum was stamped preliminary draft and contains multiple other methods that EPA appears to have abandoned or revised in the interim. This memorandum therefore does not provide a clear description of EPA's current methods. Also, the LWG commented on the memorandum (LWG 2014c) and EPA appears to have rejected those comments in total.

b. The rationales for several aspects of the RAL determination methods are not explained. For example, why did EPA use Site-wide RAL curves almost exclusively after commenting repeatedly on the 2012 draft FS that there was too much focus on Site-wide spatial scales during RAL development and other FS steps? Similarly, why does EPA show a smaller scale RAL curve for DDx only? This selective use of a smaller spatial scale for this particular COI appears arbitrary. Why do so called "Site-wide" RAL curves range in acreage covered from 2,200 acres to 180 acres? How do any of these RAL curve spatial scales relate to PRGs being compared to, which should applied using spatial scales at least roughly similar to the exposure assumption spatial scales in the BLRAs? Where do the background replacement values come from and why are they appropriate? We assume that the TPAH PRG of 970 ppb is an error, as the RAO 5 PRG used both in Sections 2 and 4 is 23,000 µg/kg.

c. EPA does not explain the rationale or process for many aspects of the proposed technology assignment approach. For example, the "smoothing" step is only described as an "algorithm." The algorithm is not in any way described and the results before and after the smoothing step are not presented (at least in a way that can be identified as such). Further, Figures 3.3-27a-f present the technology assignments resulting from the scoring matrix and are introduced well after the smoothing algorithm is mentioned. Yet these figures contain many very small scale assignments of dredging or capping that appear to constitute only a few pixels each. It is unclear whether this is the "smoothed" version or not.

d. EPA shows more than 2500 acres although it has agreed in the past that the Site is about 2200 acres. Also, EPA shows technology assignments downstream of RM 1.8. EPA indicated in the August 13 conference call that EPA did not intend to expand the Site area, but the above Site acreage and mapping inconsistencies have not been explained by EPA.

e. The technology assignment scoring matrix is presented as applying to the entire Site with only a couple of “off ramps” to the process identified. Examination of the decision trees for shallow, intermediate, and deep areas show that the scoring matrix is only used and applied in the intermediate areas (which constitute a fraction of the Site). Thus, it appears other a priori decisions that are not fully explained lead to the selection of remedial technologies over the majority of the Site area, or alternatively, the actual approach used by EPA is unclear.

f. There are multiple inconsistencies between the text and technology assignment decision trees including the following examples:

  – As noted briefly above, Figures 3.3-27 and 3.6-02 through 07 show different technology assignments in a number of intermediate to shallow areas throughout the Site. EPA could not readily identify in the July 29, 2015 meeting the sources of differences in technology assignments between the two maps. It is unclear that either map is consistent with the technology scoring matrix and decision trees presented in Section 3.

  – All text describing decision points in the decision trees involving PTW discuss that certain decisions are based on the presence of NAPL and PTW that is not reliably contained. However, all the decision trees make a distinction between PTW that is not reliably contained and PTW that is reliably contained[17]. NAPL and its role in the decision process is not mentioned in any of the decision trees. Consequently, it is unclear on every decision tree point involving PTW exactly which sediment characteristics are actually being considered in those decisions.

  – EPA indicates in the text about intermediate areas that, “Contaminated sediment will be dredged to the lesser of the RAL concentrations or 15 feet (assumed maximum depth since special design and side slope stabilization considerations would need to be conducted on an area-specific basis). If NAPL or PTW that is not reliably contained has been identified in a dredge area, then either an armored reactive cap or a reactive residual layer is assumed. Otherwise, a residual layer is assumed.” However, the decision tree figure for intermediate areas indicates a distinction between PTW that is not reliably contained and PTW that is reliably contained. Following the decisions path for PTW that is reliably contained, all post-dredge options assume a “reactive residual layer” not a “residual layer.” A similar inconsistency exists between the text and decision trees presenting the approach for navigation channel areas.

[17] As noted above, the LWG disagrees that there is such a thing as PTW that can be reliably contained, given that EPA’ PTW guidance indicates reliably contained is one of the criteria used to define PTW.

- – EPA indicates in the text for shallow areas that, “Contaminated sediment will be dredged to the lesser of the RAL concentrations or a maximum depth of 5 feet, and the dredged material will be replaced with an engineered cap to previous elevation. Otherwise, the contaminated sediment will be dredged 3 feet and replaced with an engineered cap.” However, the shallow area decision tree figure shows that for the “otherwise” step that areas dredged to 3 feet that are not PTW that is not reliably contained might be assigned either an engineered cap or a reactive cap depending on whether they are in a groundwater plume area.

g. Methods and site data used for defining NAPL in cores shown in Figures 3.3-28 and 29 are not described. In the July 29, 2015 roll-out meeting EPA indicated that “site data were used” in this determination. However, for example, the NAPL area defined in Figure 3.3-29 for the Gasco area differs somewhat from the substantial product areas delineated for the Gasco EE/CA, using methods previously directed by EPA on that site. Similarly, LSS has indicated in past comments that no evidence of NAPL exists in cores near the Arkema site, and yet EPA defines some NAPL areas in this region in Figure 3.3-28. Given that there is no obvious agreement on the NAPL areas defined in these figures, this strongly indicates the need for EPA to carefully explain the methods and rationale leading to these NAPL figures.

h. In general, Figure 3.3-40 is inconsistent with the text of Sections 3 and 4 (which are inconsistent with each other). The sediment and soil disposal decision tree framework presented in Figure 3.3-40 does not identify a treatment step for PTW that cannot be reliably contained, and provides an option for the waste to be disposed in either Subtitle C or D. However, the Section 4 text for each alternative states that removed PTW that is not reliably contained is assumed to undergo ex situ treatment. (For example see Section 4.2.2.4 Reduction of Toxicity, Mobility or Volume.) Figure 3.3-40 also indicates that treatment is required for PTW containing source material, PAHs or DDx, but that after treatment the waste can be disposed in Subtitle C or D or even the CDF depending on a number of factors. Section 4.3.4 text inconsistently states “All PTW treated ex-situ in Alternatives B through G is assumed to be disposed at a RCRA Subtitle C facility.” Footnote 1 of the decision tree appears to state that MGP remediation waste may require special management not only if it exceeds TCLP criteria but also in the case of “special considerations such as worker safety and equipment decontamination.” It is unclear precisely what this means, but we are unaware of what criteria EPA would use to determine that “special considerations” required Subtitle C disposal of MGP remediation waste or any regulatory basis for those “special considerations,” let alone for the application of land disposal restrictions to non-RCRA hazardous waste. Figure 3.3-40 is inconsistent with the 2009 EPA order for the Gasco Sediment Site.

i. Critical terms used to describe remedial technologies are not clearly defined and are intermixed. For example, as noted above, EPA refers many times to "caps," "engineered caps," and "armored caps" among other formulations. It is unclear when these are referring to the same or different types of caps.

j. The methods EPA uses to derive the quantities shown in Section 3.6 are poorly explained or unexplained. Also, a rapid review of the quantities presented in Section 3 shows multiple inconsistencies and apparent errors. One example is that Section 3.6.3.3 indicates for Alternative B that ex situ treatment is assumed for "273,440 to 364,590 cy of the dredge material" in intermediate areas only. However, Section 3.6.3 indicates that for the entire Alternative B "ex-situ treatment of 240,840 to 321,120 cy" will occur. How can the ex situ treatment in the intermediate portion of on an alternative be larger than the volume of ex situ treatment for the entire alternative?

k. Institutional controls are introduced for each technology. However, except under capping, this text mostly discusses issues related to Site-wide fish advisories that are not linked directly to any particular technology. Also, the text varies between these sections in unexplained ways. There is also a "common elements" discussion where institutional controls are discussed again in yet another slightly different way. As a result, the role of institutional controls as part of individual technologies and in the overall alternatives is generally unclear.

l. Many of the statements in the text are actually simplified assumptions that are not supported or are supported by citing just one reference (that may not actually support the statement in question). For example, EPA states, "Articulated fixed-arm dredges are the preferred dredging option due to the greater bucket control that can be achieved with this dredge type versus cable-operated dredges. This greater bucket control has proven to limit contaminant resuspension and release at other sediment sites (AMEC et al. 2012)." Anchor QEA disagrees that the reference noted provides sufficient information to suggest, much less prove, that articulated fixed-arm dredges do a significantly better job of limiting contaminant resuspension. The LWG disagree with EPA making major decisions about dredging methods based on one reference of questionable relevance and ignoring information from other recent projects (as presented in the 2012 draft FS). Further it is inappropriate to make such a statement about a particular dredging method, without acknowledging that actual construction means and methods should be determined during remedial design based on site- specific considerations and construction performance requirements set forth in remedial design documents.

m. EPA indicates that a review of chemical concentrations (particularly metals) across the Site indicated the potential for additional sediments to be classified as characteristic hazardous wastes based on the RCRA toxicity criteria. This review is not explained further. How was the review done? Is it the same as the review presented later in Section 4? What samples and locations exceeded RCRA toxicity criteria and for what chemicals? How did these determinations play into alternative development, given that the cost appendix does not indicate any additional ex situ treatment or disposal decisions related to RCRA hazardous waste?

n. EPA indicates that "maximum contaminant concentrations in sediment suitable for placement in the CDF were derived in the T4 60 Percent Design (Anchor QEA 2011), and are provided in Appendix D." However, Appendix D exclusively presents cap modeling methods and results used to identify PTW that is not reliably contained. Is EPA implying that this same modeling approach for the PTW evaluation was used to determine materials that can be placed in a CDF? If so, how do the cap modeling methods sufficiently mimic a CDF berm and containment design presented in the T4 60 percent Design?

o. EPA's technology decision trees contain references to "groundwater plume" areas. However, no map of the assumed groundwater plume areas is presented anywhere in Section 3. Consequently, it is impossible to determine where these decision points apply in the overall technology assignment approach. EPA indicated in the July 29, 2015 roll-out meeting that the RI groundwater information was used to define plume areas. As far as we are aware, the RI information does not indicate exact areas of each groundwater plume. Consequently, some intermediate steps remain unexplained that make the analysis impossible to reproduce.

p. EPA provides no back up data, appendix, or methods statements that describe how alternative durations and construction schedules were determined. A couple of pieces of information are provided regarding "productivity" including the number of days of dredging per season and that dredging is assumed to occur 24 hours a day and 6 days a week. EPA provided some additional production rate text on August 14, 2015, but this text does not address issues related to dredging efficiency (see Comment 5c), throughput time of the thermal desorption ex situ treatment plant, time allowed for sheetpile and other BMP installation and removal, time allowed for structure removal (which EPA indicates will happen for disused structures), how capping and other material placement activities are expected to occur, and construction sequencing details.

q. EPA indicates, "Estimates of shear stress throughout the Site are shown on Figure 3.3-18." The shear stress map is not very informative, because EPA compared these values to a critical shear stress value to identify erosional areas. A map of the resulting erosional areas should be presented. Without this information, the matrix scoring approach for erosional areas cannot be understood or reproduced. Also, Figure 3.3-18 incorrectly presents bed shear stress for the 25-year event, not the 2-year event as indicated.

r. As noted above in the discussion of the riverbank issue, the riverbank remediation approach appears to be very simplistic, but there is far too little detail to reproduce or even fully understand the approach, and there are major inconsistencies in the approach as described (see above discussion of regrading to 1.7V:1H versus 1V:5H slopes).

s. Table 3.6-3 presents "import volumes," which is specifically noted to include material for "Containment, Dredge Residuals Management, and In-Situ Treatment." However, EPA's technology decision trees also specify complete backfill of dredge prisms in a large proportion of the dredge areas. It is unclear whether these backfill volumes are included in EPA's analysis or not. Given the different purpose of dredge backfill, these volumes should be called out separately.

t. Regarding PTW determinations, Table 3.3-7 notes that only chlorobenzene and naphthalene cannot be reliably contained. However, page 3-21 says PCBs and dioxins/furans can be reliably contained, but "an additional evaluation will need to be conducted on dredged sediment containing any PTW related to NAPL, PAHs or DDx. Thus, ex situ treatment is applied to dredged sediment and soil containing these contaminants." The rationale for conducting a detailed PTW reliably contained analysis and then ignoring the results for NAPL, PAHs, and DDx is entirely unexplained. It is also unclear from the cost appendix whether EPA actually included areas above the PTW high-concentration threshold for PAHs and DDx as part of the ex situ treatment volumes or not.

u. EPA has never provided a description of or the actual FS database that was updated by EPA to incorporate new upland riverbank soils data from the DEQ source control program and newer data collected by the City at RM6E and by the RM11E Group and City at RM11E. If EPA added new data it is unclear whether established data quality review procedures were followed in updating the database. Consequently, it is not possible to check or reproduce certain data analysis steps such as mapping concentrations. If the newer data were not used by EPA, the LWG would like to know how EPA intends to use these data in development of the conceptual remedy and proposed plan.

Some examples of inconsistencies and missing information in Section 4 include:

a. Most of the references are missing.

b. Information referred to in appendices does not exist in some cases (e.g., additional residual risk figures purported to be in Appendix H are not present).

c. Costs from Table CS-ALT in Appendix G do not match the costs presented in Table 4.3-1 or Table 4.3-2.

d. The costs in Table 4.3-1 and 4.3-2 do not match each other.

e. The areas and volumes presented in Section 3 are not consistent with the areas and volumes presented in Table 4.3-1 in most cases.

f. The construction durations presented in Table 4.3-2 are consistent with those provided in Section 3.

g. The alternative maps included in Section 4 (Figures 4.2-11 and 4.2-14 through 4.2-17) match Figures 3.6-02 through 3.6-07 from Section 3, which are the figures that EPA indicated verbally during the August 13, 2015 conference call were incorrect.

h. As noted above, RCRA waste determinations on page 4-23 appear to conflict with determinations described in Section 3. Requirements for treatment of large areas of the Site indicated by figures cited on page 4-23 do not appear to be included in Section 3 quantities and, therefore, may not be included in Section 4 costs. It is unclear whether this is purposeful or not.

i. EPA indicates that Site-wide residual risk estimates were also made, but no Site-wide results are presented.

j. Page 4-6 indicates that "predicted concentrations in sediment at MNR Year 0 are used to estimate concentrations in fish and shellfish tissue." No estimates of tissue concentrations are subsequently presented.

k. Appendix H indicates, "Results of the risk reduction evaluation are presented in Section XX and Appendix YY." The references to other sections and appendices are incomplete and no additional appendix relevant to this subject appears to exist.

l. There are inconsistencies in the presentation of residual risks. For example, Section 4.2.2 regarding magnitude of residual risk for RAO 1 for Alternative B is given as "generally less than 5×10^{-5}," while Table 4.3-1 indicates risks for RAO 1 as "3×10^{-5}."

m. There are inconsistencies in dredge volumes given in the text and tables. Using Alternative B as an example, dredge volumes are given in Table 4.3-1 and Section 4.2.2.3 as 872,000 cy and in Section 4.2.2.6 as 462,000 cy. Additionally, Table 4.3-2 indicates 892,000 cy for disposal.

n. There are inconsistencies between capping volumes presented in the text and capping volumes listed in tables. Using Alternative B as an example, Section 4.2.2.3 states that "Various caps would be placed over 34 acres of the site," while Table 4.3-2 includes 7 acres of capping and 7 acres of in situ treatment.

o. Table 4.3-1 does not include any O&M costs. Costs associated with long-term O&M are given in Sections 4.2.1-4.2.6. For example, Section 4.2.2.7 states that long-term O&M for Alternative B is estimated to be $596,500,00 ($14,560,000 in present value) over an additional 70 years.

p. Section 4 introduces PRGs for dioxin/furan congeners that were not included in Section 2. The following PRGs are included in EPA's Table 4.2-1:

    i. HxCDF: Section 2 does not include a PRG for RAO 1 for this congener and three other congeners listed below. Section 2 presents only a 2,3,7,8-TCDD TEQ PRG for RAO 1. The HxCDF PRG in Table 4.2-1 happens to be equal to the TCDD PRG of 0.001µg/kg divided by the TEF but that does not appear to be the case for all congeners (e.g., PeCDF).

ii. EPA's August 18, 2015 Table 4.2-1 and related figures also present a PRG for RAO 2 for this congener of 0.001 µg/kg (denoted "background ND"). EPA's July 29, 2015 Section 2 presented an HxCDF PRG for RAO 2 of 0.000002 µg/kg. No background value was summarized in Section 2 for HxCDF, and therefore, it is unclear where this PRG came from.

iii. PeCDD, PeCDF, TCDF - Section 2 does not include a PRG for RAO 1 for these congeners. Section 2 presents only a 2,3,7,8-TCDD TEQ PRG for RAO 1. Evaluating the remedy effectiveness for alternatives using these PRGs is therefore inconsistent with Section 2.

iv. HxCDF RAO 6 PRG is inaccurately presented as being based on otter exposures in Table 4.2-1. Per EPA Section 2, the PRG of 0.003 µg/kg is based on Osprey (egg) per EPA Section 2.

q. The final page of Appendix H indicates that post-remediation SWACs for RAO 1 were evaluated on a rolling whole RM basis, which is not consistent with Figures 4.2-1a and b which present SWACs on a 0.5 RM basis.

r. The y axis label for the ecological residual risk figures presented in Section 4 may be misleading and should be clarified that the data represent HQs, rather than "risk".

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